Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction

2 June 2014

Original: English

2014 Meeting
Geneva, 1-5 December 2014

Meeting of Experts
Geneva, 4-8 August 2014
Item 6 of the provisional agenda
Standing agenda item: review of developments in the field of science and technology related to the Convention

Advances in science and technology related to the Convention

Summary

The Seventh Review Conference decided that the 2012 to 2015 intersessional programme would include a Standing Agenda Item on review of developments in the field of science and technology related to the Convention. This paper expands upon and updates the background information document on advances in scientific and technology prepared by the ISU for the 2013 Meeting of Experts (BWC/MSP/2013/MX/INF.01/Rev.1), the background paper on advances that have potential benefits for the Convention prepared for the 2012 Meeting of Experts (BWC/MSP/2012/MX/INF.3), and the overview of advances in enabling technologies provided to the 2012 Meeting of Experts (BWC/MSP/2012/MX/INF.1).

I. Advances in science and technology

A. Introduction

1. The Seventh Review Conference decided that under the Standing Agenda Item reviewing developments in the field of science and technology related to the Convention States parties will consider:

"(a) new science and technology developments that have potential for uses contrary to the provisions of the Convention;

(b) new science and technology developments that have potential benefits for the Convention, including those of special relevance to disease surveillance, diagnosis and mitigation;

(c) possible measures for strengthening national biological risk management, as appropriate, in research and development involving new science and technology developments of relevance to the Convention;

(d) voluntary codes of conduct and other measures to encourage responsible conduct by scientists, academia and industry;

(e) education and awareness-raising about risks and benefits of life sciences and biotechnology.

(f) science- and technology-related developments relevant to the activities of multilateral organizations such as the WHO, OIE, FAO, IPPC and OPCW;

(g) any other science and technology developments of relevance to the Convention."[1]

2. The Seventh Review Conference also decided that "the following topical scientific subjects will be considered in the years indicated:

"(a) advances in enabling technologies, including high-throughput systems for sequencing, synthesizing and analyzing DNA; bioinformatics and computational tools; and systems biology (to be considered in 2012);

(b) advances in technologies for surveillance, detection, diagnosis and mitigation of infectious diseases, and similar occurrences caused by toxins in humans, animals and plants (to be considered in 2013).

(c) advances in the understanding of pathogenicity, virulence, toxicology, immunology and related issues (to be considered in 2014);

(d) advances in production, dispersal and delivery technologies of biological agents and toxins (to be considered in 2015)."[2]

3. This background information document provides an overview of:

(a) advances in the understanding of pathogenicity, virulence, toxicology, immunology and related issues;

(b) advances related to dealing with disease, updating background information provided in 2013 (BWC/MSP/2013/MX/Rev.1) and in 2012 on advances with potential benefits for the Convention (BWC/MSP/2012/MX/INF.3);

(c) advances in enabling technologies, updating background information provided in 2012 (BWC/MSP/2012/MX/INF.1)

B. General Trends

4. The background document on advances in science and technology compiled by the ISU for the Seventh Review Conference identified six trends: convergence between disciplines; increasing understanding of the underlying principles and mechanisms of the life sciences; shifting focus of priority areas within commercial biotechnology; a greater geographical distribution of capacity; open science; and media, perceptions and interactions with society. The 2013 ISU background document on the same topic noted a seventh trend: the increased use of research collaborations.[3] These trends all remain extant. Some updates

[1] BWC/CONF.VII/7, part III, paragraph 22.
[2] BWC/CONF.VII/7, part III, paragraph 23.
[3] BWC/MSP/2013/MX/INF.1/Rev.1

include the continued shift away from small molecule drugs to biotechnology products for the pharmaceutical industry;[4] continued R&D efforts for hundreds of new vaccines and drugs;[5] and ongoing initiatives to make vaccines and drugs available to all, noticeable for instance through the growth in the biosimilars market, estimated to reach $1.95 billion by 2018, and the continued expansion of the Developing Countries Vaccine Manufacturers Network.[6]

5. An eighth trend may now be added: the growing tacit knowledge requirement for life science work.[7] Researchers attempting to replicate experiments raised the alarm on the growing difficulty of reproducing research; this issue has become so severe that those seeking to replicate results obtained at another lab are now encouraged to do so through joint work.[8] This trend is, in part, driving the seventh trend: research collaborations are set up to bring together the "barrage of high-end equipment that no one can afford,"[9] but also to pool the tacit knowledge required to effectively employ these pieces of sensitive equipment. The security implications of tacit knowledge have also been considered in the context of: synthetic biology;[10] and for the regime addressing the threat posed by biological weapons.[11]

II. Advances in the understanding of diseases, including pathogenicity, virulence, toxicology, and immunology

A. Transmissibility

6. There is an increased understanding in the nature of mutations necessary to make certain diseases air-transmissible, sometimes without causing loss of pathogenicity. This has been achieved in part through controversial gain-of-function research. Of note were

---

[4] Kevin Grogan, "Tufts report confirms domination of biotech products," PharmaTimes, 14 November 2013, http://www.pharmatimes.com/article/13-11-14/Tufts_report_confirms_domination_of_biotech_products.aspx.

[5] "Medicines in Development for Vaccines 2013," PhRMA, http://www.phrma.org/medicines-in-development-for-vaccines-2013.
Lynne Taylor, "US Biopharma: 452 drugs for rare diseases now in R&D," PharmaTimes, 9 October 2013, http://www.pharmatimes.com/article/13-10-09/US_biopharma_452_drugs_for_rare_diseases_now_in_R_D.aspx.

[6] Alaric Daerment, "Biosimilars Market to reach $1.95 billion by 2018, study finds," MedTech, November 25, 2013, https://www.medtech.org/news/global.aspx?recid=4207 ;
Sonia Pagliusi et al., "Developing Countries Vaccines Manufacturers Network: Doing good by making high-quality vaccines available to all," Vaccine (18 April 2013), http://www.ncbi.nlm.nih.gov/pubmed/23598479.

[7] In this paper, the term tacit knowledge is being used to refer to knowledge that is obtained through hands-on experience, as opposed to through written instructions and other forms of passive learning.

[8] Mina Bissell, "Reproducibility: The Risks of the Replication Drive," Nature, Vol. 503 (20 November 2013): 333-334, http://www.nature.com/news/reproducibility-the-risks-of-the-replication-drive-1.14184.

[9] Ewen Callaway, "Structural biologists share their toys," Nature, Vol. 483 (1 March 2012): 15-16, http://www.nature.com/news/structural-biologists-share-their-toys-1.10122.

[10] Catheribe Jefferson et al, "Synthetic Biology and Biosecurity: How scared should we be?", Kings College London, May 2014, http://www.kcl.ac.uk/sspp/departments/sshm/research/Research-Labs/CSynBI@KCL-PDFs/Jefferson-et-al-(2014)-Synthetic-Biology-and-Biosecurity.pdf

[11] James Revill and Catherine Jefferson, "Tacit knowledge and the biological weapons regime", Science and Public Policy, 2013, pp1-14, http://spp.oxfordjournals.org/content/early/2013/12/11/scipol.sct090.abstract

- two 2013 studies which produced a series of hybrids of the H5N1 and H1N1 avian influenza viruses capable of spread via respiratory droplets. The research teams used a similar methodology as employed in the 2013 H5N1 papers but employed high-throughput approaches, such as directed evolution;[12]
- the announcement by a collection of leading researchers of the intent to undertake gain-of-function research on H7N9 avian influenza viruses. The authors proposed and discussed the ethics of their planned studies before carrying out the research; and[13]
- a 2014 study in which a research group undertook gain-of-function research with the H7N1 avian influenza virus and were able to demonstrate that this virus was able to spread in ferrets (a mammal) without a loss of virulence.[14]

B. Pathogenicity and virulence

7. There is new data and analysis on inhalational variants of diseases caused by pathogens that might be relevant to the Convention, including: a new hypothesis for the mechanism by which inhalational anthrax kills;[15] and a more detailed understanding of primary pneumonic plague.[16]

8. There is a growing knowledge base on *strain-specific* disease virulence and pathogenicity, including: why certain influenza strains are more adept than others at growing in human lung tissue;[17] the discovery of a virulence plasmid in some Non-

---

[12] Robert Roos, "Study: Lab-made H5N1-H1N1 viruses spread in guinea pigs," University of Minnesota, Center for Infectious Disease Research and Policy, 2 May 2013, http://www.cidrap.umn.edu/news-perspective/2013/05/study-lab-made-h5n1-h1n1-viruses-spread-guinea-pigs;
Ying Zhang et al., "H5N1 Hybrid Viruses Bearing 2009/H1N1 Virus Genes Transmit in Guinea Pigs by Respiratory Droplet," *Science*, Vol. 340, no. 6139 (21 June 2013): 1459-1463, http://www.sciencemag.org/content/340/6139/1459.abstract;
Wei Zhang et al., "An Airborne Transmissible Avian Influenza H5 Hemagglutinin Seen at the Atomic Level," *Science*, Vol. 340, no. 6139 (21 June 2013): 1463-1467, http://www.sciencemag.org/content/340/6139/1463.abstract.

[13] Ron A. M. Fouchier, Yoshihiro Kawaoka, et al., "Avian Flu: Gain-of-function experiments on H7N9," *Nature* Vol. 500 (8 August 2013): 150-151, http://www.nature.com/nature/journal/v500/n7461/full/500150a.html.

[14] Troy C. Sutton et al., "Airborne Transmission of Highly Pathogenic H7N1 Influenza in Ferrets," Journal of Virology (2 April 2014), http://jvi.asm.org/content/early/2014/03/27/JVI.02765-13.abstract

[15] Kenneth Mark Coggeshall et al., "The sepsis model: an emerging hypothesis for the lethality of inhalation anthrax, "*Journal of Cellular and Molecular Medicine*, Vol 17, no. 7 (17 July 2013): 914-920, http://www.ncbi.nlm.nih.gov/pubmed/23742651.

[16] Roger D. Pechous et al., "Early Host Cell Targets of Yersinia pestis during Primary Pneumonic Plague" *PLOS Pathogens* (3 October 2013), http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.1003679.

[17] Jessica Knepper et al., "The Novel Human Influenza A(H7N9) Virus is Naturally Adapted to Efficient Growth in Human Lung Tissue," *mBio*, Vol. 4, no. 5 (8 October 2013), http://mbio.asm.org/content/4/5/e00601-13.abstract.

Typhoidal Salmonella strains;[18] and how strain differences lead to different innate immune responses, which in turn impacts mortality rates.[19]

9. There have been advances in the understanding of plant-pathogens interaction, including the structure and function of virulence proteins.[20]

10. There is a better understanding of the role played by some cytokines, which are small proteins involved in cell signalling, during the course of diseases, for example the detected cytokine response in A(H1N1)pdm09 influenza patients.[21]

11. There has been progress in understanding how bacteria and viruses spoof or hijack host machinery to regulate their own proliferation,[22] for example for the bacteria *Streptococcus pyogenes*.[23]

C. Toxicology

12. A new botulinum toxin serotype, Type H, was discovered in 2013, over 40 years after the last serotype discovery.[24] There are now eight known serotypes of this toxin. The

---

[18] Christina Bronowski et al., "Genomic Characterisation of Invasive Non-Typhoidal Salmonella enterica Subspecies enterica Serovar Bovismorbificans Isolates from Malawi," *PLOS Neglected Tropical Diseases* (14 November 2013), http://www.plosntds.org/article/info%3Adoi%2F10.1371%2Fjournal.pntd.0002557.

[19] Jian Wu et al., "Strain-specific innate immune signaling pathways determine malaria parasitemia dynamics and host mortality," *PNAS*, Vol. 111, no. 4 (28 January 2014): E511-20, http://www.ncbi.nlm.nih.gov/pubmed/24474800.

[20] Lennart Wirthmueller et al., "On the front line: structural insights into plant-pathogen interactions," Nature Reviews Microbiology, Vol.11, no.11 (November 2013): 761-776, http://www.nature.com/nrmicro/journal/v11/n11/full/nrmicro3118.html.

[21] A. Bradley-Steward et al., "Cytokine responses in patients with mild of severe influenza A(H1N1) pdm09," The Journal of Clinical Virology, Vol. 58, no. 1 (September 2013): 100-107, http://www.ncbi.nlm.nih.gov/pubmed/23790455.

[22] Vanderbilt University Medical Center, Department of Pathology, Microbiology, and Immunology, "Microbial Pathogenesis and Host Interactions Journal Club," 2 May 2014, http://www.mc.vanderbilt.edu/root/vumc.php?site=vmcpathology&doc=35941 ;

[23] Moshe Baruch et al., "An Extracellular Bacterial Pathogen Modulates Host Metabolism to Regulate Its Own Sensing and Proliferation," *Cell*, Vol. 156, no. 1-2 (19 January 2014): 97-108, http://www.cell.com/cell/abstract/S0092-8674%2813%2901539-0.

[24] The two original papers are:
Jason R. Barash, Stephen S. Arnon, "A Novel Strain of Clostridium botulinum That Produces Type B and Type H Botulinum Toxins," *The Journal of Infectious Diseases*, Vol. 209, no. 2 (7 October 2013): 183-191, http://jid.oxfordjournals.org/content/early/2013/10/07/infdis.jit449.short.
Nir Dover et al., "Molecular Characterization of a Novel Botulinum Neurotoxin Type H Gene," The Journal of Infectious Diseases, Vol. 209, no. 2 (7 October 2013): 192-202, http://jid.oxfordjournals.org/content/209/2/192.
Several discussion papers have also been published:
David C. Hooper, Martin S. Hirsch, "Novel Clostridium botulinum Toxin and Dual Use Research of Concern Issues," The Journal of Infectious Diseases, Vol. 209, no. 2 (7 October 2013): 167, http://jid.oxfordjournals.org/content/209/2/167;
Michel R. Popoff, "Botulinum Neurotoxins: More and More Diverse and Fascinating Toxic Proteins," *The Journal of Infectious Diseases*, Vol. 209, no. 2 (7 October 2013): 168-169, http://jid.oxfordjournals.org/content/209/2/168;
David A. Relman, "Inconvenient Truths" in the Pursuit of Scientific Knowledge and Public Health," *The Journal of Infectious Diseases*, Vol. 209, No. 2 (7 October 2013): 170-172, http://cisac.stanford.edu/publications/inconvenient_truths_in_the_pursuit_of_scientific_knowledge_and_public_health/.

genetic sequence was voluntarily withheld by the researchers, at least until an antitoxin can be developed.

13. There is a greater understanding of ricin toxin including: work on neutralizing monoclonal antibodies for ricin, with vaccine potential;[25] and the creation of a ricin genetic interaction map, with therapy potential.[26]

14. New details of toxin evolution has been uncovered thanks to the genome sequencing of toxins; for example, the dynamic predator-prey evolution of cobra toxin has been analysed using this technique.[27]

15. Efforts have been made to improve the efficacy of testing the toxicity of chemicals, including through the use of living human tissues grown through 3D bioprinting.[28]

D. Resistance

16. There has been progress in identifying resistance genes, in identifying mutations which lead to these resistance genes, and in knowing whether mutations for resistance impact replication and pathogenicity. Some examples include: the identification of malaria resistance genes in a species of mosquito;[29] the partial identification of H1N1 mutations leading to Tamiflu resistance;[30] and the finding that oseltamivir resistance gain in H7N9 can occur without substantially altering its virulence and pathogenicity.[31]

---

[25] Anastasiya Yermakova, David J. Vance, Nicholas J. Mantis, "Sub-Domains of Ricin's B Subunit as Targets of Toxin Neutralizing and Non-Neutralizing Monoclonal Antibodies," *PLoS One*, Vol. 7, no. 9 (September 11, 2012), http://www.ncbi.nlm.nih.gov/pubmed/22984492.

[26] Bassick MC et al., "A systematic mammalian genetic interaction map reveals pathways underlying ricin susceptibility," *Cell*, Vol. 152, no. 4 (8 February 2013): 909-922, http://www.ncbi.nlm.nih.gov/pubmed/23394947.

[27] Freek J. Vonk et al., "The king cobra genome reveals dynamic gene evolution and adaptation in the snake venom system," *PNAS* (22 October 2013) http://www.pnas.org/content/early/2013/11/27/1314702110.abstract.

[28] Signe Brewster, "NIH partners with Organovo to test new drugs on 3D printed living tissue," GIGAOM, January 14, 2014, https://gigaom.com/2014/01/14/nih-partners-with-organovo-to-test-new-drugs-on-3d-printed-living-tissue/;
Matthew D. Segall, Chris Barber, "Addressing Toxicity Risk when Designing and Selecting Compounds in Early Drug Discovery," *Drug Discovery Today* (19 January 2014), http://www.ncbi.nlm.nih.gov/pubmed/24451294.

[29] Jun Li et al., "Genome-block expression-assisted association studies discover malaria resistance genes in Anopheles gambiae," *PNAS* (11 November 2013), http://www.pnas.org/content/early/2013/11/27/1321024110.short?rss=1.

[30] Nicholas Renzette, "Evolution of the Influenza A Virus Genome during Development of Oseltamivir Resistance *In Vitro*," *Journal of Virology*, Vol. 88, no. 1 (October 2013): 272-281, http://jvi.asm.org/content/88/1/272.

[31] Rong Hai et al., "Influenza A(H7N9) virus gains neuramidnidase inhibitor resistance without loss of in vivo virulence or transmissibility," Nature Communications, Vol. 4 (June 23, 2013), http://www.nature.com/ncomms/2013/131210/ncomms3854/full/ncomms3854.html.

E. Immunology and host response avoidance

17. Progress has been made in identifying immune system evasion mechanisms used by a number of pathogens, including: those which use RNA structural motifs;[32] the evasion role of surface structures of flaviviruses;[33] and a new hypothesis which holds that the primary effect of the *B. anthracis* toxin in inhalational anthrax cases is to assist in host response evasion.[34]

18. Progress has also been made in understanding pathogen - host response dynamics, including: the interplay between *Mycobacterium tuberculosis* and the host macrophage;[35] better understanding of MicroRNSas and their role in host antimicrobial defense;[36] and an increased recognition of the crucial role of miRNA in regulating antimicrobial defense.[37]

19. Investigation into the persistence of immune response in humans to disease has continued, including that of persistent immune responses following Ebola Virus infection.[38]

20. A "generic" antibody-binding protein has been found, and which may be used by certain bacteria for host immune response evasion.[39] The protein is capable of binding with a broad array of antibodies, preventing the latter from functioning. Previously, antibody-binding proteins had been highly specific to a particular antibody. Research on potential applications is ongoing, including for novel anti-bacterial therapeutics.

F. How pathogens evolve and spread

21. Advances in enabling technologies, such as genome sequencing, continue to reveal valuable information on a number of pathogens. Some examples of new findings include

---

[32] Jennifer L. Hyde et al., "A Viral RNA Structural Element Alters Host Recognition of Nonself RNA," Science, Vol. 343, no. 6172 (February 14, 2014): 783-787, http://www.sciencemag.org/content/343/6172/783.abstract.

[33] David L. Akey, "Flavivirus NS1 Structures Reveal Surfaces for Associations with Membranes and the Immune System," *Science*, Vol. 343, no. 6173 (21 February 2014): 881-885, http://www.sciencemag.org/content/343/6173/881.abstract.

[34] Kenneth Mark Coggeshall et al., "The sepsis model: an emerging hypothesis for the lethality of inhalation anthrax," *The Journal of Cellular and Molecular Medicine*, Vol. 17, no. 7 (July 2013): 914-920, http://www.ncbi.nlm.nih.gov/pubmed/23742651.

[35] Manikuntala Kundu, Joyoti Basu, "Mycobacterium tuberculosis and the host macrophage: maintaining homeostatis or battling for survival?" *Current Science*, Vol. 105, no. 5 (September 2013): 617, http://connection.ebscohost.com/c/articles/90546356/mycobacterium-tuberculosis-host-macrophage-maintaining-homeostasis-battling-survival.

[36] Katherine J. Siddle et al., "A Genomic Portrait of the Genetic Architecture and Regulatory Impact of microRNA expression in response to infection," Genome Research (2014), http://genome.cshlp.org/content/early/2014/01/30/gr.161471.113.

[37] Cristel Archambaud et al., "The Intestinal Microbiota Interferes with the microRNA Response upon Oral Listeria Infection," mBio, Vol. 4, no. 6 (10 December 2013), http://mbio.asm.org/content/4/6/e00707-13.

[38] Ariel Sobarzo et al., "Persistent Immune Responses after Ebola Virus Infection," The New England Journal of Medicine, Vol. 369 (2013): 492-493, http://www.nejm.org/doi/full/10.1056/NEJMc1300266.

[39] The Scripps Research Institute, "The Ultimate Decoy: Scientist Find Unique Protein that Misdirects Immune System," *News & Views*, Vol. 14, Issue 7 (3 March 2014), www.scripps.edu/newsandviews/e_20140303/lerner.html;
Rajesh K. Grover et al., "A Structurally Distinct Human Mycoplasma Protein that Generically Blocks Antigen-Antibody Union," *Science*, 343, no. 6171 (7 February 2014): 656-661, https://www.sciencemag.org/content/343/6171/656/suppl/DC1.

the formulation of a hypothesis to explain Ebola virus evolution based on an analysis of 27 Ebola virus strains from 5 species;[40] increased evidence that bats are a natural reservoir for Ebola and Marburg viruses based on the complete viral genome sequence studies of four viral hemorrhagic fever outbreaks;[41] and the discovery based on genomic analysis that the *Y. pestis* strain responsible for the first known human plague pandemic is a novel branch in the *Y. pestis* phylogeny.[42]

22. Progress continues on building a better understanding of influenza, in particular its capability for mutation, including: details of reassortments between H7N9 and H9N2 strains;[43] and the determination of actual substitution positions in H3N2, which revealed that H3N2 mutations were more predictable than thought.[44]

III. Advances in enabling technologies

A. Characterizing biological systems and networks

23. DNA sequencing costs have continued to decrease: in January 2014, the price for sequencing a genome was down to roughly $4000, from just over $5000 in October 2013.[45] Similarly, the cost of human gene mapping has steadily gone down.[46]

24. Developments in gene sequencing are also illustrating the importance of non-coded regulatory control, for example, there has been progress in mapping the epigenetic basis of complex traits.[47]

25. Proteomics (the study of all the proteins in an organism) has continued to benefit from technology developments and new techniques. For instance, there has been progress in rapidly determining the biological functions of a proteome by application of Proteomics Expansion Pipeline (PEP) technology;[48] and a new method called High-Resolution IsoElectric Focusing (HiRIEF) Liquid Chromatography–Mass Spectrometry (LC-MS)

---

[40] Y. H. Li, S. P. Chen, "Evolutionary History of Ebola Virus," Epidemiology and Infection, Vol. 142, no. 6 (June 2014): 1138-1145, http://www.ncbi.nlm.nih.gov/pubmed/24040779.

[41] C.G. Albarino, "Genomic analysis of filoviruses associated with four viral hemorrhagic fever outbreaks in Uganda and the Democratic Republic of the Congo in 2012," *Virology*, Vol. 442, no. 2 (1 August 2013): 97-100, http://www.sciencedirect.com/science/article/pii/S0042682213002237.

[42] David M. Wagner et al., "Yersinia pestis and the Plague of Justinian 541-543 AD: a genomic analysis," *The Lancet Infectious Diseases*, Vol. 14, no. 4 (April 2014): 319-326, http://www.thelancet.com/journals/laninf/article/PIIS1473-3099%2813%2970323-2/abstract.

[43] Z. Meng et al., "Possible Pandemic Threat From New Reassortment of Influenza A(H7N9) Virus in China," *Eurosurveillance* 19, no. 6 (February 2014).

[44] Björn F. Koel et al., "Substitutions Near the Receptor Binding Site Determine Major Antigenic Change During Influenza Virus Evolution", *Science*, Vol. 342, no. 6161 (22 November 2013): 976-979, https://www.sciencemag.org/content/342/6161/976.abstract.

[45] National Human Genome Research Institute, "DNA Sequencing Costs: Data from the NHGRI Genome Sequencing Program (GSP)," 8 April 2014, http://www.genome.gov/27541954.

[46] Ashlee Vance, "Human Gene Mapping Price to Drop to $1,000, Illumina Says," *Bloomberg*, 15 January 2014, http://www.bloomberg.com/news/2014-01-15/human-gene-mapping-price-to-drop-to-1-000-illumina-says.html.

[47] Sandra Cortijo et al., "Mapping the Epigenetic Basis of Complex Traits," *Science*, Vol. 343, no. 6175 (7 March 2014): 1145-1148, https://www.sciencemag.org/content/343/6175/1145.abstract.

[48] Xing Wang, Michael Davies, David Wang, "New Tool Facilitates Functional Proteomics: PEP Technology Can Also Be Used to Speed Protein Purification," *Genetic Engineering & Biotechnology* News, Vol. 34, no. 3 (1 February 2014), http://www.genengnews.com/gen-articles/new-tool-facilitates-functional-proteomics/5126/.

enables deeper proteome coverage and unbiased proteogenomics, enabling identification of previously unknown protein-coding loci.[49]

26. Advances in metabolomics (the study of all the biochemical processes or metabolism of an organism) have potential application to microbial forensics. For example, unique strain-specific metabolic processes can increasingly be matched with particular environmental niches, allowing for greater specificity in the origin of a pathogen.[50]

27. A genetic interaction mapping system for mammals has been designed. The technique is based on combinatorial RNA interference, and allows one to map genetic pathways of different phenotypes.[51]

28. Experimental-computational techniques for inferring network models of cell response to perturbations has continued to mature.[52] These models can be used, for example, to estimate drug effects on particular cell lines.

B. Engineering biological systems and networks

29. It is now possible to design organisms with an expanded genetic alphabet.[53] That is, one can add new unnatural base pairs to expand on the standard two-base-pair genetic alphabet (A-T and G-C) in DNA.

30. It is now increasingly possible to employ DNA manipulation and gene circuit engineering on mammalian cells, in part through the use of the CRISPER-Cas9 system. For example, gene-modified monkeys have been engineered using this method.[54]

31. The capability to genetically modify insects is increasingly harnessed; for instance, the use of genetically modified mosquitoes has been approved in Brazil in an attempt to fight dengue fever.[55]

32. The synthesis of a eukaryotic chromosome has been achieved.[56] Progress continues in the quest to synthesize an entire yeast genome and is being pursued by an intercontinental research group.

---

[49] Rui M M Branca et al., "HiRIEF LC-MS enables deep proteome coverage and unbiased proteogenomics," *Nature Methods*, Vol. 11 (2014): 59-62, http://www.nature.com/nmeth/journal/v11/n1/full/nmeth.2732.html.

[50] Jonathan M. Monk et al., "Genome-scale metabolic reconstructions of multiple Escherichia coli strains highlight strain-specific adaptations to nutritional environments," *PNAS*, (25 November 2013), http://www.pnas.org/content/early/2013/11/20/1307797110.abstract.

[51] Bassick MC et al., "A systematic mammalian genetic interaction map reveals pathways underlying ricin susceptibility," *Cell*, Vol. 154, no. 4 (14 February 2013): 909-922, http://www.ncbi.nlm.nih.gov/pubmed/23394947.

[52] Evan J. Molinelli et al., "Perturbation Biology: Inferring Signaling Networks in Cellular Systems," *PLOS Computational Biology* (19 December 2013), http://www.ploscompbiol.org/article/info%3Adoi%2F10.1371%2Fjournal.pcbi.1003290.

[53] Denis A. Malyshev et al., "A Semi-synthetic Organism with an Expanded Genetic Alphabet," *Nature*, Vol. 509 (15 May 2014): 385-388, http://www.nature.com/nature/journal/v509/n7500/full/nature13314.html.

[54] Yuyu Niu et al., "Generation of Gene-Modified Cynomolgus Monkey via Cas9/RNA-Mediated gene Targeting in One-Cell Embryos," *Cell*, Vol. 156, no. 4 (13 February 2014): 836-843, http://www.cell.com/abstract/S0092-8674%2814%2900079-8.

[55] "Brazil approves use of genetically modified mosquitoes," New Scientist, 23 April 2014, http://www.newscientist.com/article/dn25457-brazil-approves-use-of-genetically-modified-mosquitoes.html#.U3Cgclfokak..

33. There is an increased capacity for the design and employment of biological scaffolds. For example, there is a new understanding of bacteria growth patterns, which can be used to create synthetic gene circuits for biological scaffolds.[57]

34. It is now possible to "write" membranes onto graphene surfaces through the use of Lipid Dip-Pen Nanolithography, which can be applied to biosensor design.[58]

35. The capability to "reprogram" killer T lymphocyte cells, for instance to specifically target cancer cells or HIV, is now well established.[59] This research provides an avenue for novel disease treatment.[60]

36. There is progress in achieving better control of production processes. For instance, there is now a better understanding of noise propagation, which can cause significant variation in gene expression and phenotype in genetically identical cells exposed to the same environment.[61] This has applications for handling noise in synthetic circuits.

37. Complementing lab work developments, there have also been developments in prediction and planning software, including: generating effective RNA molecule designs through a successful crowd-sourced-with-expert-feedback project;[62] and progress in computational enzyme design.[63]

C. Gathering and manipulating biological information

38. The development of enhanced algorithms to assist with gathering and manipulating biological information and meta-information is becoming increasingly important. For example, DNA sequencing algorithms often limit the speed of sequencing, rather than the device itself.[64] Meta-information analysis, where software is used to scan and make

---

[56] Narayana Annaluru et al., "Total Synthesis of a Functional Designer Eukaryotic Chromosome," Science, Vol. 344, no. 6179 (April 4, 2014): 55-58, http://www.sciencemag.org/content/344/6179/55.abstract ; Elizabeth Pennisi, "Building the Ultimate Yeast Genome," *Science*, Vol. 343, no. 6178 (28 March 2014): 1426-1429, https://www.sciencemag.org/content/343/6178/1426.summary.

[57] Stephen Payne et al., "Temporal control of self-organized pattern formation without morphogen gradients in bacteria," *Molecular System Biology*, (8 October 2013), http://www.ncbi.nlm.nih.gov/pubmed/24104480.

[58] Michael Hirtz et al., "Multiplexed biomimetic lipid membranes on graphene by dip-pen nanolithography," *Nature Communications*, Vol. 4, (10 September 2013), http://www.nature.com/ncomms/2013/131010/ncomms3591/full/ncomms3591.html.

[59] Raul Vizcardo et al., "Regeneration of human tumor antigen-specific T cells from iPS cells derived from mature CD8+ T cells," *Cell Stem Cell*, Vol. 12, no. 1 (3 January 2013): 31-36, http://www.cell.com/cell-stem-cell/abstract/S1934-5909%2812%2900711-4 ; Nishimura T. et al., "Generation of rejuvenated antigen-specific T cells by reprogramming to pluripotency and redifferentiation," *Cell Stem Cell*, Vol. 12, no. 1 (3 January 2013): 114-126, http://www.cell.com/cell-stem-cell/abstract/S1934-5909%2812%2900636-4.

[60] "Revolutionary techniques Could help harness patients' own immune cells to fight disease," *ScienceNewsline*, 3 January 2013, http://www.sciencenewsline.com/articles/2013010320520009.html.

[61] Tsukasa Kouno et al., "Temporal dynamics and transcriptional control using single-cell gene expression analysis," *Genome Biology*, Vol. 14, no. 10 (24 October 2013), http://genomebiology.com/2013/14/10/R118.

[62] Jeehyung Lee et al., "RNA design rules from a massive open laboratory," *PNAS* (27 January 2014), <http://www.pnas.org/content/early/2014/01/23/1313039111.abstract>.

[63] Gert Kiss et al., "Computational enzyme design," *Angewandte Chemie*, Vol. 52, no. 22 (25 March 2013): 5700-5725, http://onlinelibrary.wiley.com/doi/10.1002/anie.201204077/abstract.

[64] Michael C. Schatz, Ben Langmead, "The DNA Data Deluge," *IEEE Spectrum*, 27 June 2013, http://spectrum.ieee.org/biomedical/devices/the-dna-data-deluge.

predictions based on scientific literature, has shown success in harnessing the increasingly vast worldwide life science output.[65]

39. Improvements have been made in modelling and predicting the impacts of overexpressing genes. This is an approach common in research to determine gene function and in biotechnology to increase yields.[66]

40. There is continuing interest in improving the ability to convert biological material into data and back.[67] The idea is as follows: an organism (or part of an organism) is sequenced in one place, the sequenced data is transmitted electronically to a second location, and the sequence data is then used to recreate the organism. A recent paper detailing a platform that could be used in this manner for vaccine development has been published.[68]

D. Generic enabling technologies

41. There is a better understanding of genome dynamics during evolution, more specifically in how the rate and nature of genotypic changes relate to phenotypic changes.[69]

42. There have been improvements in the capability of separating microbial DNA from host DNA, which will lead to improvements in microbial genome databases and a better understanding of how these are linked to organism functions.[70]

43. The CRISPER-Cas9 system continues to be refined, allowing for better genome editing abilities, based on: a better understanding of the Cas9 enzyme family;[71] and new guide RNAs for the system.[72]

---

[65] Tom Simonite, "Software Mines Science Papers to Make New Discoveries," *MIT Technology Review*, 25 November 2013, http://www.technologyreview.com/news/520461/software-mines-science-papers-to-make-new-discoveries/.

[66] Allon Wagner et al., "Computational evaluation of cellular metabolic costs successfully predicts genes whose expression is deleterious," *PNAS* (29 June 2013), http://www.pnas.org/content/early/2013/11/05/1312361110.

[67] Andrew Pollack, "Developing a Fax Machine to Copy Life on Mars," *The New York Times*, 17 November 2013, http://www.nytimes.com/2013/11/18/science/developing-a-fax-machine-to-copy-life-on-mars.html?_r=0.

[68] Philip Dormitzer et al., "Synthetic generation of influenza vaccine virus for rapid response to pandemics," Science Translational Medicine, Vol.5 iss.185 (15 May 2013): 1-12, http://stm.sciencemag.org/content/5/185/185ra68.full.pdf

[69] Jeffrey E. Barrick, Richard E. Lenski, "Genome Dynamics during Experimental Evolution," *Nature Reviews Genetics*, Vol. 14 (29 October 2013): 827-839, http://www.nature.com/nrg/journal/v14/n12/full/nrg3564.html

[70] Fiona Stewart et al., "Selective Enrichment of Microbial DNA: Separation by Differential Methylation Density Reduces Whole Microbiome DNA Sequencing Cost," *Genetic Engineering & Biotechnology News*, Vol. 34, no. 3 (1 February 2014), http://www.genengnews.com/keywordsandtools/print/1/33754/.

[71] Martin Jinek, "Structures of Cas9 Endonucleases Reveal RNA-Mediated Conformational Activation," Science, Vol. 343, no. 6176 (14 March 2014), http://www.sciencemag.org/content/343/6176/1247997.abstract.

[72] Yanfang Fu et al., "Improving CRISPR-Cas nuclease specificity using truncated guide RNAs," Nature Biotechnology, Vol. 32 (2014): 279-284, http://www.nature.com/nbt/journal/v32/n3/full/nbt.2808.html.

IV. Dealing with diseases and toxins

A. Detection

44. Progress continues on toxin detection, including: enhanced quality assurance for the detection of biological toxins;[73] the development of biochips capable of detecting several different toxins;[74] progress in ricin detection equipment;[75] progress in saxitoxin detection without the use of antibodies or animals;[76] and a biosensor for the detection of paralytic shellfish toxins in marine algae.[77]

45. Simultaneous multiple bacteria fingerprinting technology has progressed, in part through applications of nanotechnology and photonics. For instance, a system to detect meningitis has been developed where silver nanoparticles are combined with a sample, a laser beam is shone onto it, and the shift in wavelength is used to identify bacteria.[78]

46. DNA sample analysis continues to gain speed, with multiple detection applications.[79]

B. Prevention and prophylaxis

47. The technique of genetically engineering live vaccines continues to mature.[80]

48. A wide range of vaccines based on a number of innovative techniques are currently in development. For instance, there have been: attempts at bivalent vaccines based on

---

[73] Establishment of Quality Assurance for the Detection of Biological Toxins of Potential Bioterrorism Risk, http://equatox.net/

[74] Chirstopher Pöhlmann, Thomas Elßner, "Fully-Automated Electrochemical Biochip Platform for Rapid, Simultaneous and Sensitive Bioagent Detection," http://www.foi.se/Global/V%C3%A5ra%20tj%C3%A4nster/Konferenser%20och%20seminarier/CBW%20symposium/Proceedings/Elssner.pdf.

[75] Anderson GP et al., "Single domain antibody-quantum dot conjugates for ricin detection by both fluoroimmunoassay and surface plasmon resonance," *Analytica Chimica Acta*, Vol. 786 (5 July 2013): 132-138, http://www.sciencedirect.com/science/article/pii/S0003267013006594 ; Huebner M et al., "A Glyco-chip for the Detection of Ricin by an Automated Chemiluminescence Read-out System," *Analytical Sciences*, Vol. 29, no. 4 (2013): 461-466.

[76] Sara M. Handy et al., "First report of the use of a saxitoxin-protein conjugate to develop a DNA aptamer to a small molecule toxin," *Toxicon*, Vol. 61 (January 2013): 30-37.

[77] Julie P. Meneely et al., "Development and validation of an ultrasensitive fluorescence planar waveguide biosensor for the detection of paralytic shellfish toxins in marine algae," *Biosensors and Bioelectronics*, Vol. 41 (15 March 2013): 691-697.

[78] "Lasers used in Meningitis Tests by Strathclyde University Scientists," *BBC News*, 12 February 2014, http://www.bbc.com/news/uk-scotland-glasgow-west-26146806. Kirsten Gracie et al., "Simultaneous detection and quantification of three bacterial meningitis pathogens by SERs," Chemical Science, Vol.5 (2014): 1030-1040, http://pubs.rsc.org/en/Content/ArticleLanding/2014/SC/c3sc52875h#!divAbstract

[79] DARPA $1 million challenge: "Identify Organisms from a Stream of DNA Sequences," *Innocentive*, https://www.innocentive.com/ar/challenge/9933138; "DTRA-WMD Announces $1 Million Algorithm Challenge," *PRWeb*, 13 December 2012, http://www.prweb.com/releases/dtra/algorithm/prweb10233480.htm.

[80] James E. Galen, Roy Curtiss 3rd, "The Delicate Balance in Genetically Engineering Live Vaccines," *Vaccine* (December 23, 2013), http://www.ncbi.nlm.nih.gov/pubmed/24370705.

antibodies, for example an Ebola virus – Rabies Virus dual vaccine;[81] and attempts at a pan H-1 influenza vaccine.[82]

49. Finally, innovative research has been conducted on how a building's architectural design affects bacterial communities.[83] On top of wide-ranging public health and biosafety applications, this has potential security applications in designing buildings to be more attack-resistant and easier to decontaminate.

C. Therapeutics

50. Antibodies are also being harnessed for therapeutics; for example, progress towards an Ebola virus treatment based on antibodies that could be effective following the onset of symptoms.[84]

51. There have also been progress in the use of biopharming; for instance, the aforementioned experimental antibody therapeutics for Ebola virus disease is produced by a bioengineered tobacco plant.

52. mRNA therapeutics has seen continued commercialization.[85] It is hoped that the technique will speed up development and manufacture of treatments for rare diseases.[86]

53. Deep-sea marine ecosystems are increasingly tapped for their potential to provide novel sources of chemicals for therapeutics; for instance a potential anthrax antibiotic has been developed based on a marine microorganism product.[87]

---

[81] Joseph E. Blaney, "Antibody Quality and Protection from Lethal Ebola Virus Challenge in Nonhuman Primates Immunized with Rabies Virus Based Bivalent Vaccine," *PLOS Pathogens* (May 30, 2013), http://www.plospathogens.org/article/info%3Adoi%2F10.1371%2Fjournal.ppat.1003389.

[82] Florian Kramer et al., "Assessment of influenza virus hemagglutinin stalk-based immunity in ferrets," *Journal of Virology*, Vol. 88, no. 6 (January 8, 2014): 3432-3442, http://www.ncbi.nlm.nih.gov/pubmed/24403585.

[83] Steven W. Kembel et al., "Architectural Design Derives the Biogeography of Indoor Bacterial Communities," PLOS ONE (January 29, 2014), http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0087093.

[84] James Pettitt et al., "Therapeutic Intervention of Ebola Virus Infection in Rhesus Macaques with the MB-003 Monoclonal Antibody Cocktail," *Science Translational Medicine*, Vol. 5, no. 199 (21 August 2013): 199ra133, http://stm.sciencemag.org/content/5/199/199ra113.

[85] For more information on such approaches see: R. Scott McIvor, "Therapeutic Delivery of mRNA: The Medium Is the Message," *Molecular Therapy*, Vol. 19, no. 5 (2011): 822-823, http://www.nature.com/mt/journal/v19/n5/full/mt201167a.html.

[86] "Alexion, Moderna to Develop Rare Disease-Fighting mRNA Therapeutics," GEN, 13 January 2014, http://www.genengnews.com/gen-news-highlights/alexion-moderna-to-develop-rare-disease-fighting-mrna-therapeutics/81249355/.

[87] Kyoung Hwa Jang et al., "Anthracimycin, a Potent Anthrax Antibiotic from a Marine-Derived Actinomycete," *Angewandte Chemie*, Vol. 52, no. 30 (22July 2013): 7822-7824, http://onlinelibrary.wiley.com/doi/10.1002/anie.201302749/abstract.

Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction

6 August 2014

Original: English

2014 Meeting
Geneva, 1-5 December 2014

Meeting of Experts
Geneva, 4-8 August 2014
Item 6 of the provisional agenda
Standing agenda item: review of developments in the field of science and technology related to the Convention

Advances in science and technology related to the Convention

Submitted by the Implementation Support Unit

Corrigendum

1. **Cover page**

   Insert subtitle *to read* as above

2. **Paragraph 31**

   For the existing text *substitute*

   31. The capability to genetically modify insects is increasingly harnessed.[1]

[1] New Scientist, 23 April 2014, http://www.newscientist.com/article/dn25457.

GE.14-10451 (E)
1410451

Please recycle

Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction

3 July 2014

Original: English

2014 Meeting
Geneva, 1-5 December 2014

Meeting of Experts
Geneva, 4-8 August 2014
Item 5 of the provisional agenda
Standing agenda item: cooperation and assistance, with a particular focus on strengthening cooperation and assistance under Article X

Background information on continuing challenges and obstacles to developing international cooperation, assistance and exchange

Submitted by the Implementation Support Unit

Summary

The Seventh Review Conference decided that the 2012 to 2015 intersessional programme would include a Standing Agenda Item on cooperation and assistance, with a particular focus on strengthening cooperation and assistance under Article X. The Conference further decided that under this item, States Parties would consider, inter alia, "challenges and obstacles to developing international cooperation, assistance and exchange in the biological sciences and technology, including equipment and material, for peaceful purposes to their full potential, and possible means of overcoming these." Further to requests made by delegations in the course of consultations with the Chairman, this paper provides an update to a prior background document on some of the specific challenges and obstacles to developing international cooperation, assistance and exchange that have been identified by States Parties and international organizations in the course of meetings of the Convention and in other relevant settings.

GE.14-07332 (E)

1407332

Please recycle

I. Introduction

1. The Implementation Support Unit produced a background paper for the 2013 Meeting of Experts on challenges and obstacles to developing international cooperation, assistance, and exchange, in the context of strengthening cooperation and assistance under Article X.[1]

2. The Implementation Support Unit has been tasked with updating this document for the 2014 Meeting of Experts. This background paper presents specific challenges and obstacles highlighted since the 2012 Meeting of Experts. Similar sources of material have been used, with issues drawn from synthesis papers, working papers, ISU annual reports, and from external organizations. As with the previous paper, this is an indicative rather than an exhaustive list, intended to illustrate the main kinds of challenges and obstacles that have been identified and to organise them thematically.

II. Challenges and obstacles identified in synthesis papers

3. Challenges and obstacles to developing international cooperation, assistance and exchange continue to be raised in presentations and discussions at the Meetings of Experts. These are then reflected in the Chairman's Synthesis of considerations, lessons, perspectives, recommendations, conclusions and proposals drawn from the presentations, statements, working papers and interventions on the topic under discussion at the Meeting of Experts, commonly known as the "synthesis paper." This document is produced by the Chairman following each Meeting of Experts as a resource for States Parties to draw upon for preparing the subsequent Meeting of States Parties. The synthesis paper is not agreed upon by States Parties and as such has no status beyond reflecting the Chairman's synthesis of what one or more States Parties have said at the Meeting of Experts. Relevant extracts from the 2012 and 2013 synthesis papers are reproduced here and update the list provided in BWC/MSP/2013/MX/INF.2.

4. The synthesis paper of 2013 (BWC/MSP/2013/L.1), recognized the "importance of the full and comprehensive implementation of Article X," and noted a number of items which may need addressing in order to improve implementation, including:[2]

(a) Developing more precise criteria on which cooperation and assistance activities fall under the BWC and which do not;

(b) Facilitating implementation of Article X by strengthening implementation of Article III, while ensuring that factors such as lack of technical capability in developing countries are not used to hamper international cooperation;

(c) Providing open and transparent reporting of activities of States Parties in transferring knowledge, information, technologies, materials and equipment designed to combat infectious diseases, irrespective of their funding sources;

(d) Discuss[ing] compulsory licensing, in consultation with the World Intellectual Property Organization (WIPO) and the World Health Organization (WHO), as a means of overcoming obstacles to provision of medicines to development countries.

---

[1] BWC/MSP/2013/MX/INF.2.

[2] BWC/MSP/2013/L.1, paragraph 2.

5. The synthesis paper of 2012 (BWC/MSP/2012/L.1) recognized "the importance of overcoming challenges and obstacles to international cooperation, assistance and exchange in the biological sciences and technology" and listed the following challenges:[3]

(a) Balance implementation of Article X and Article III of the Convention, and in this regard promote appropriate export controls in conformity with the obligations set out in the Convention;

(b) Coordinate key activities in order to enhance synergy and avoid duplication;

(c) Develop procedures to promote full, effective, and non-discriminatory implementation of Article X;

(d) Develop procedures for the settlement of disputes arising from concerns about the implementation of Article X;

(e) Utilize the database to facilitate requests for and offers of assistance and cooperation among States Parties.

III. Challenges and obstacles identified in working papers

6. States have continued to submit working papers explicitly related to cooperation, assistance, and exchange. Four such papers were submitted for the 2013 Meeting of States Parties, three were submitted at the 2013 Meeting of Experts, and three such papers submitted at the 2012 Meeting of States Parties.[4] These documents identified a number of challenges to developing international cooperation, assistance, and exchange. As in the previous background document, they have been summarized below under thematic headings.

A. Restrictions and limitations on transfer and exchange

7. A number of States Parties continued to raise points regarding restrictions and limitations on transfer and exchange.

8. The Islamic Republic of Iran submitted a working paper on behalf of the Group of the Non-aligned Movement and Other States Parties to the BWC at the 2013 Meeting of Experts which stated that "one of the main challenges of the full, effective and non-discriminatory implementation of Article X is the existence of unjustified restrictions and or limitations, including the politically motivated ones, imposed against States Parties in contravention with the provisions and inconsistence with the spirit of the Convention," noting that "there is an urgent need for the removal of any such restrictions and/or limitations."[5]

9. A working paper submitted by China for the 2012 Meeting of States Parties noted the "need to promote biotechnology exchange and cooperation" in part by removing "export restrictions against the objectives of international cooperation."[6]

---

[3] BWC/MSP/2012/L.1, paragraph 3.

[4] BWC/MSP/2013/INF.2, INF.3, INF.4, INF.5 ; BWC/MSP/2013/MX/WP.6, WP.15, WP. 17 ; BWC/MSP/2012/INF.1, WP.8, WP.10.

[5] BWC/MSP/2013/MX/WP.17, paragraph 5.

[6] Unofficial translation of the Chinese original: BWC/MSP/2012/WP.10

B. Institutional mechanisms

10. A number of States Parties mentioned the need to strengthen current mechanisms or establish new mechanisms in order to develop international cooperation, assistance and exchange.

11. The aforementioned Islamic Republic of Iran working paper, submitted on behalf of the Group of the Non-aligned Movement and Other States Parties to the BWC at the 2013 Meeting of Experts, also reiterated the group's "firm position on the need for an effective mechanism to ensure the full, effective and non-discriminatory implementation on the Article X."[7]

12. The aforementioned working paper submitted by China to the 2012 Meeting of States Parties noted that it was "important to improve the existing notification mechanism on disease outbreaks and strengthen the information sharing in counter-bioterrorism and other biosafety issues."[8]

C. Difficulty of assessing needs

13. As in previous years, States Parties highlighted issues of assessing needs.

14. The working paper submitted by Iraq at the 2013 Meeting of Experts noted the importance of an accurate assessment of gaps in the context of the provision of assistance and international cooperation.[9]

15. The aforementioned Islamic Republic of Iran working paper, submitted on behalf of the Group of the Non-aligned Movement and Other States Parties to the BWC at the 2013 Meeting of Experts, also noted a need to "identify and address the needs in terms of equipment, materials and scientific and technological information regarding the use of the bacteriological and toxin agents for peaceful purposes."[10]

IV. Challenges and obstacles identified by the Implementation Support Unit

A. Implementation of the database system to facilitate requests for and offers of exchange of assistance and cooperation among States Parties

16. In accordance with its mandate, the Implementation Support Unit (ISU) has continued to flag problems with facilitating cooperation and assistance among States Parties through its annual reports to States Parties.

17. The Seventh Review Conference called for the establishment of a database system to facilitate requests for and offers of exchange of assistance and cooperation among States Parties (BWC/CONF.VII/7, part III, paragraphs 17-20). As mandated, the ISU established a database; however, its use remains limited, with very few states having requested assistance to date. In its 2012 report, the ISU noted that "no matches of offers and requests have yet been notified to the ISU," and that "The low rate of submissions from States Parties to the database is a point of concern that States Parties may wish to discuss; the ISU is ready to work with States Parties to find ways of making this important tool successful in

[7] BWC/MSP/2013/MX/WP.17, paragraph 8.

[8] Unofficial translation of the Chinese original: BWC/MSP/2012/WP.10

[9] Unofficial translation of the Arabic original: BWC/MSP/2013/MX/WP.15

[10] BWC/MSP/2013/MX/WP.17, paragraph 7 (a).

operation."[11] This trend continues: in its 2013 report, the ISU reported a single case of assistance, noting that it had "been informed that assistance has been provided as a result of a request in the database."[12] This echoes concerns raised by several States Parties, which have called for "strengthening the utilization and improving the operation of the cooperation database."[13]

---

[11] BWC/MSP/2012/2, paragraphs 27, 34.

[12] BWC/MSP/2013/4, paragraph 25.

[13] See for instance, BWC/MSP/2013/MX/WP.17, paragraph 9.

Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction

23 July 2014

Original: English

2014 Meeting
Geneva, 1-5 December 2014

Meeting of Experts
Geneva, 4-8 August 2014
Item 5 of the provisional agenda
Standing agenda item: cooperation and assistance, with a particular focus on strengthening cooperation and assistance under Article X

Background information on continuing challenges and obstacles to developing international cooperation, assistance and exchange

Corrigendum

Submitted by the Implementation Support Unit

Paragraph 6

For the existing text substitute

6. States have continued to submit documents explicitly related to cooperation, assistance, and exchange. Five such documents were submitted for the 2013 Meeting of States Parties, three were submitted at the 2013 Meeting of Experts, and three were submitted at the 2012 Meeting of States Parties.[1] These documents identified a number of challenges to developing international cooperation, assistance, and exchange. As in the previous background document, they have been summarized below under thematic headings.

[1] BWC/MSP/2013/WP.9; BWC/MSP/2013/INF.2; BWC/MSP/2013/INF.3; BWC/MSP/2013/INF.4; BWC/MSP/2013/INF.5; BWC/MSP/2013/MX/WP.6; BWC/MSP/2013/WP.15; BWC/MSP/2013/WP.17; BWC/MSP/2012/INF.1; BWC/MSP/2012/WP.8; BWC/MSP/2012/WP.10.

GE.14-09510 (E)

1409510

Please recycle

BWC/MSP/2014/MX/INF.5

4 August 2014

English only

Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction

2014 Meeting
Geneva, 1-5 December 2014

Biological Weapons Convention
Meeting of Experts
Geneva, 4-8 August 2014
Item 5 of the agenda
Standing agenda item: cooperation and assistance, with a particular focus on strengthening cooperation and assistance under Article X

Report on USA implementation of Article X of the Biological and Toxin Weapons Convention

Submitted by the United States of America

Article X

(1) The States Parties to this Convention undertake to facilitate, and have the right to participate in, the fullest possible exchange of equipment, materials and scientific and technological information for the use of bacteriological (biological) agents and toxins for peaceful purposes. Parties to the Convention in a position to do so shall also cooperate in contributing individually or together with other States or international organizations to the further development and application of scientific discoveries in the field of bacteriology (biology) for prevention of disease, or for other peaceful purposes.

(2) This Convention shall be implemented in a manner designed to avoid hampering the economic or technological development of States Parties to the Convention or international cooperation in the field of peaceful bacteriological (biological) activities, including the international exchange of bacteriological (biological) agents and toxins and equipment for the processing, use or production of bacteriological (biological) agents and toxins for peaceful purposes in accordance with the provisions of the Convention.

GE.14-09975 (E)
1409975

Please recycle

I. Background

1. The United States is firmly committed to fulfilling all of its obligations under the Biological and Toxin Weapons Convention (BWC), including those under Article X of the Convention. Activities relevant to implementation of Article X include – but are by no means limited to – assistance programmes, and encompass a wide range of activities in support of the overall advancement and application of the life sciences for peaceful purposes. The Seventh Review Conference rightly recognized this, and in addition to establishing an Assistance and Cooperation Database, requested States Parties to report on their implementation, in order to produce a more complete picture of Article X implementation.

2. Article X embodies an international commitment to partnership, sharing of information, networking, and the development of mutually beneficial outcomes. While the United States has supported, and will continue to support, capacity building and other forms of assistance for those countries seeking it, formal "assistance" programmes comprise only a part of this much larger undertaking. Through our broad-ranging efforts, the United States and the international community have worked together collectively to pursue shared goals, including, *inter alia*:

- Improving global health security by preventing, detecting, and responding effectively to disease;
- Advancing educational and collaborative opportunities for the international scientific community;
- Contributing to the advancement of biological sciences for peaceful purposes;
- Creating an international system that promotes innovation, investment, and access to scientific advances to address environmental, health, energy, and other needs; and
- Building sound, appropriate regulatory and oversight systems at all levels to ensure the safe and peaceful application of dual-use materials and technologies, and the effective implementation of BWC and United Nations Security Council Resolution (UNSCR) 1540 obligations.

3. We continue to invest significant resources in these efforts. In the United States system, exchange, cooperation, and assistance in fulfillment of our Article X commitments are provided in a variety of ways: bilaterally by the United States. Government to other national entities; through national contributions to international organizations; and by individuals, industry, foundations, and academia, all of which are critical players in American civil society. This multidimensional approach is reflected in this report, which is organized around the three basic commitments contained in Article X: (1) to facilitate the fullest possible exchange of information, equipment, and materials for peaceful purposes; (2) to contribute to the advancement and application of the life sciences; and (3) to implement the BWC in ways that avoid hampering the economic and technological development of States Parties.

4. We believe that the exchanges during the BWC intersessional process have been productive in building relationships and facilitating real assistance on issues of practical concern to States Parties. However, as previous Review Conferences have noted, while the large number of U.S. programs and wide range of ongoing efforts underway contribute to our implementation of Article X, such efforts do not take place solely, or even primarily, in the BWC forum. The United States will continue to utilize this broad diversity of institutions, stakeholders, and fora in order to pursue our shared goals for international cooperation and assistance.

5. The breadth and scope of U.S. contributions and assistance precludes a comprehensive listing of each and every program in its entirety, but enclosed in this paper is a selection of examples that illustrate the range of our activity and amply document our full commitment to the letter and spirit of Article X, including links to a variety of online resources. We have also included a specific example of a request for assistance and a U.S. response facilitated through the Assistance and Cooperation Database. Additionally, the United States provides one-page descriptions of some of our assistance programmes at each Meeting of Experts and Meeting of States Parties, along with contact information. These one-page descriptions are also submitted to the BWC Implementation Support Unit, and included in the Assistance and Cooperation Database established by the 2011 Review Conference.

II. Bilateral, regional, and multilateral efforts to facilitate the fullest possible exchange of biological equipment, materials, and information for peaceful purposes

6. The United States engages actively through bilateral, regional, and multilateral channels, and through these substantial interactions works to facilitate the exchange of biological equipment, materials, and information and the application of scientific advances for peaceful purposes. The United States Government, in particular, provides support that enables scientists to participate in and foster the exchange of ideas that advances our mutual understandings in the life sciences.

7. The United States is one of the largest economies in the world and the largest exporter and importer of goods and services, with U.S. exports hitting a record of $2.3 trillion in 2013. In 2010, the United States launched the National Export Initiative (NEI), which has sought to improve conditions that directly affect the private sector's ability to export. The NEI works to remove trade barriers abroad, by helping firms (especially small businesses) overcome the hurdles to entering new export markets, by assisting with financing, and in general by working with our international partners, among other steps. In January 2013, the International Trade Administration began previewing New.Export.Gov, which streamlines assistance for exporters. Such measures, along with others to enhance the international trade system, promote investment, trade, and economic growth—all of which promote both the production and the broadest possible exchange of life science-related products and technologies.

8. In addition, the United States promotes exchange in the life sciences in a variety of smaller-scale but more focused ways:

9. The Department of Health and Human Services supports multiple international exchange programmes for scientific research, including the following:

- Food and Drug Administration (FDA)'s International Scientist Exchange Program;
- FDA's Foreign National Training Program;
- National Institute of Health (NIH)'s Visiting Program for scientists, designed to train and conduct collaborative research at NIH;
- NIH/Fogarty International Center, which provides grants to train researchers and build sustainable research capacity in more than 75 low and middle income countries;
- NIH/National Cancer Institute (NCI)'s Short Term Scientist Exchange Program; and

- NIH/National Institute for Allergies and Infectious Disease (NIAID)'s International Centers of Excellence in Research program, which develops research programmes in resource-poor countries through partnerships with local scientists to provide training and improve laboratory and clinical infrastructure.

10. The Department of Health and Human Services Biomedical Advanced Research and Development Authority (BARDA) provided more than $50 million in cooperation with WHO to strengthen the ability of developing countries to sustainably produce influenza vaccines, potentially reducing the global threat of influenza pandemics. In addition, BARDA provided over $20 million to support vaccine adjuvant technology transfer, biomanufacturing workforce training, and clinical trial and manufacturing technical support to developing country influenza vaccine manufacturers. BARDA has also successfully established public-private partnerships with industry partners to develop novel antibiotics, including a five-year, $200 million agreement with GlaxoSmithKline, designed to support the development of an entire portfolio of candidate antibiotic therapies.

11. The Department of State supports biological scientific engagement through a series of vehicles, including:

- Through more than 50 bilateral science and technology agreements, which provide a formal mechanism for United States Government departments and agencies to promote collaboration on scientific endeavors with partner nations; and
- Through endowed science and technology funds used to support patents, publication, and commercial sales.

12. American colleges and universities also engage in joint research collaborations with colleagues across the globe, and educate many of the world's emerging scientists through undergraduate, graduate, and post-graduate training. In 2012, there were more than 284,000 foreign graduate students enrolled in U.S. universities, with more than 163,000 enrolled in science and engineering studies. The number of foreign students enrolled in U.S. undergraduate programmes continues to rise, with an 11% increase between 2011 and 2012 to approximately 351,000. One third of all foreign students enrolled in U.S. undergraduate programmes are enrolled in science and engineering fields.

13. Additionally, many nongovernmental organizations and foundations based in the United States host scientific exchanges and forums to bring together scientists from around the world. Some of these entities explicitly sponsor the scientific development of foreign researchers, including the $200 million Howard Hughes Medical Institute International Early Career Scientist awards program. Another noteworthy example is the Intel international Science and Engineering Fair (ISEF), a program of the Society for Science and the Public. ISEF is the world's largest pre-college science competition. Each year it enables more than 1,700 high school students from about 70 countries, regions, and territories to display their independent research and compete for over $5 million in awards. The American Society for Microbiology also has a robust program to engage international partners, fostering collaboration and partnership, and providing specialized programmes in science communication, evidence-based policy making, microbiology mentorship, lab biosafety and biorisk management.

14. Open access: Many United States institutions support "open access" – the principle of making research results broadly available, free of charge. One of the first book publishers to provide open access was the National Academies Press, publisher for the National Academy of Sciences, Institute of Medicine, and other arms of the National Academies. They have provided free online full-text editions of their books alongside priced, printed editions since 1994. In 1997, the U.S. National Library of Medicine (NLM) made Medline, the most comprehensive index to medical literature on the planet, freely available through PubMed. Since April 2008, the National Institutes of Health has required

that all articles arising from NIH funding be made freely available via PubMed Central within 12 months of publication, and in February 2013, the White House Office of Science and Technology Policy directed all Federal Agencies to develop plans to make published results of federally funded research freely available to the public within one year of publication.

15. In addition, many U.S. colleges and universities have adopted open access policies. Some of these apply only to graduate theses, and others apply to the faculty of specific schools. Some, however, apply broadly to the research of faculty at major U.S. universities. A growing number of major U.S. institutions are also making undergraduate and even some graduate courses freely available online. One of the earliest and most advanced of these initiatives is MIT's OpenCourseWare project, which began in October 2002 and now offers over 2,000 free, online courses. Johns Hopkins Bloomberg School of Public Health also offers dozens of its most popular public health courses online for free.

III. Contributions to the development and application of scientific discoveries in the life sciences for the prevention of disease, and for other peaceful purposes

16. Sometimes overlooked is the undertaking in Article X for Parties "in a position to do so" to contribute to the further development and application of the life sciences. The United States is a world leader in life sciences research and development (R&D), accounting for up to one-third of global investment in life sciences R&D. Much of this work is undertaken by the private sector, although the federal government remains the largest funder of life sciences research at U.S. colleges and universities. This makes the United States one of the foremost engines driving forward both basic science and its application, from universities to government institutes to biotech companies to amateur biologist.

17. Strengthening capabilities to prevent, detect, and treat naturally-occurring diseases is not only one of the most basic and important applications of the life sciences, it is also an important bulwark against the potential misuse of biological agents and toxins; thus, by helping other States Parties strengthen health care infrastructure and build disease surveillance capacity, we are contributing directly to the object and purpose of the BWC, including Article X obligations. To this end, the United States has provided a wide range of assistance to international partners, including, *inter alia*, the following examples designed to reduce threats, improve global detection of disease, enhance capacity to investigate and diagnose biological emergencies, prevent and respond to disease outbreaks, and improve global health.

Threat Reduction

18. The Department of State Biological Engagement Program will provide more than $37 million in fiscal year 2014 funding for programmes focused on laboratory biorisk management, disease detection and control, and cooperative research and development. These programmes were supported in partnership with countries in the Middle East and North Africa, South Asia, Southeast Asia, sub-Saharan Africa, Eurasia, and Latin America. Specific activities included:

- Biorisk assessments followed by biosecurity upgrades in public and animal health laboratories;
- Sustainable biorisk management capacity building through biosafety and biosecurity technical trainings, as well as facilitating a broader awareness of biological nonproliferation issues; and

- Enhancing public and animal disease detection and control capabilities through international scientific and technical exchanges.

19. The Department of Defense is projected to spend a total of over $2 billion through its Cooperative Biological Engagement Program (CBEP) between fiscal year 2012 and fiscal year 2019, and allocated $260 million to this effort in fiscal year 2014 alone. CBEP is focused on reducing the threat posed by pathogens of security concern and related materials and expertise, as well as other emerging infectious disease risks. These programmes were supported in partnership with countries in Eurasia, Southeast Asia, South and Central Asia, the Middle East and sub-Saharan Africa. CBEP provides assistance across the following areas:

- Dismantling, destroying, and preventing the sale, theft, diversion, or use of stockpiles of biological weapons (BW), means of delivery, and BW-related equipment, technology, and infrastructure;
- Enhancing partner country/region's capability to identify, consolidate, and secure collections of pathogens and diseases of security concern
- Enhancing partner country/region's capability to rapidly and accurately survey, detect, diagnose, and report biological terrorism and outbreaks of pathogens and diseases of security concern in accordance with international reporting requirements.

Disease Surveillance and Response

20. In partnership with other nations, international organizations, and public and private stakeholders, the United States launched the Global Health Security Agenda in February 2014, with the intent to prevent and reduce the likelihood of disease outbreaks, detect threats early to save lives, and rapidly respond to outbreaks with a coordinated multisectoral engagement. The United States seeks to accelerate progress toward a world safe and secure from infectious disease threats. The United States is committed to this goal and multiple U.S. Government organizations, including the Centers for Disease Control and Prevention, the Department of Defense, the U.S. Agency for International Development, and the U.S. Department of Agriculture's Agricultural Research Service, have been working to build disease surveillance and response capacity around the world.

21. The Department of Defense's Global Emerging Infections Surveillance and Response System (DOD-GEIS) works to enhance global health security and armed forces health protection through a global network poised to prevent, detect, and respond to emerging microbial threats. The GEIS network and its partners support a wide range of global surveillance efforts across all emerging infectious disease (EID) surveillance through a holistic approach that includes: surveillance activities to prevent, detect and respond to infectious diseases; training and capacity building; research innovation and integration; and coordination, communication and collaboration among GEIS partners to facilitate responsive information sharing. In 2014, GEIS network surveillance and capacity building efforts reached 69 countries. This program effectively communicates information from its surveillance activities to support increased public awareness and understanding of important global issues and shaping of public health decisions. Surveillance findings are routinely shared with the respective Ministries of Defense (MoD) and Ministries of Health (MoH) of the host partner countries. GEIS encourages its partners to present and publish their findings in medical journals, at scientific meetings and to be compliant with the International Health Regulations.

22. In 2014, GEIS distributed $45.7 million to support two different kinds of surveillance activities – ongoing sustainment initiatives and novel proposals. Approximately two-thirds of GEIS sustainment funding supports ongoing initiatives to maintain a robust global EID surveillance portfolio that is standardized across all regions.

The remaining one-third of funding is awarded to projects submitted in response to an annual request for proposals that address novel EIDs or surveillance efforts affecting the Department of Defense and global health communities.

23. The Centers for Disease Control and Prevention (CDC), as the nation's primary agency and worldwide leader for disease detection, has worked in partnership with countries to develop sustainable capacities to support disease surveillance and response activities. CDC's health protection activities include the Global Disease Detection and Response Program (GDD) and the Field Epidemiology Training Program (FETP). Through these programmes, CDC works to prevent, detect, and respond to infectious disease outbreaks and improve global health security by building capacity in the following areas:

- Training in field epidemiology and laboratory methods;
- Surveillance and response for emerging infectious disease threats;
- Assistance with pandemic influenza preparedness;
- Promotion of zoonotic disease investigations and control efforts;
- Risk communications; and
- Laboratory biosafety and improved laboratory systems.

24. In 2013, the total number of people covered by population-based surveillance was 22.8 million. Between 2006 and 2013, GDD detected 58 new pathogens, and deployed 270 pathogen-specific tests to be made available to partner countries. GDD also participated in 1,257 outbreak responses from 2006–2013. In 2013, CDC experts responded to outbreaks for diseases including meningitis, MERS CoV, Dengue, Nodding Syndrome, Monkeypox, novel influenza, and Chikungunya.

25. The U.S. Agency for International Development's (USAID) Emerging Pandemic Threats (EPT) program seeks to aggressively pre-empt or combat diseases that could spark future pandemics, emphasizing early identification of and response to dangerous pathogens in animals before they can become significant threats to human health. The EPT program draws on expertise from across the animal and human health sectors to build capacities for early disease detection, laboratory-based disease diagnosis, rapid disease response and containment, and risk reduction. Partners include organizations with specialized expertise in wildlife monitoring, field epidemiology and training, laboratory strengthening, and behavior change communications, as well as international partners from the World Health Organization (WHO), the United Nations Food and Agriculture Organization (FAO), and the World Organization for Animal Health (OIE). The first iteration of the EPT Program is coming to a close in September 2014. USAID is in the process of developing the second iteration, EPT-2, which will launch in October 2014.

26. The Department of Agriculture's Agricultural Research Service (ARS) is actively engaged in implementing research programmes that help prevent, detect, or improve surveillance of plant and animal disease, including emerging disease and zoonotic agents that pose a threat to human health. ARS also actively collaborates with international partners worldwide on research projects dedicated to support disease surveillance programmes for transboundary animal diseases such as animal influenza viruses with epizootic and/or pandemic potential, Foot-and-Mouth Disease (FMD), and African Swine Fever (ASF). ARS is one of the founding members of the Global Foot-and-Mouth Research Alliance (GFRA), the African Swine Fever Research Alliance (GARA), and is an active member of the global network of expertise on animal influenza (OFFLU), which supports the FAO and OIE global efforts to control and eradicate transboundary animal diseases that impact the health of animals and people worldwide. ARS also partners with the American

Biosafety Association (ABSA) to conduct biosafety training relevant to agriculture to many national and international participants at a biennial symposium.

Enhancing Capacity

27. The United States supports the WHO's International Health Regulations (2005), which, *inter alia*:

- Provide a framework for WHO alert and response activities that are implemented in collaboration with countries to control international outbreaks and other public health risks and emergencies;
- Allow the WHO to provide support for the implementation of national capacities for epidemic preparedness and response, including laboratory capacities and early warning alert and response systems; and
- Standardize approaches for readiness and response during a public health emergency of international concern, allowing the International Health Regulations Emergency Committee to issue travel and trade recommendations based on the best evidence available.

28. The U.S.A. CDC established the Field Epidemiology (and Laboratory) Training Programmes (FELTP) in 1980, and since then CDC has helped launch more than 50 programmes around the world and produced more than 3,000 graduates. CDC currently supports workforce development through FELTPs in 46 countries, which are designed to build human capacity to characterize disease burden, respond to outbreaks, provide diagnostic capacity, and address locally-identified public heath challenges. From 2009-2012, CDC-supported FELTP residents responded to over 1100 outbreaks and conducted 606 planned studies and 1268 surveillance assessments. Through these activities, FELTP residents and graduates strengthen critical public health systems, improve the effectiveness of key public health programmes, and address their countries' public health priorities.

29. The U.S. Assistant Secretary for Preparedness and Response (ASPR) in the Department of Health and Human Services engages with international partners to create an all-hazards approach to improve our collective capabilities to deal with public health emergencies including those that arise from chemical, biological, radiological and nuclear (CBRN) threats, outbreaks of emerging infectious diseases, and natural disasters. Accordingly, the ASPR leads international programmes, initiatives and policies to strengthen domestic and international public health and medical emergency preparedness and response, including coordinating efforts to rapidly exchange information and biological materials during acute public health emergencies.

Improve Global Health

30. The U.S. Government is the leading funder of global health assistance; in FY12, the US government spent approximately $ 8.8 billion (estimated) in the Global Health Initiative alone, with an estimated $1-2 billion in additional global-health related funding in other initiatives and mechanisms. The United States is a major contributor to the Global Fund for AIDS, Tuberculosis, and Malaria, the WHO, and the Global Access to Vaccines Initiative Alliance. The U.S. Government's financial and technical contributions significantly improve and expand sustainable health systems and support the goal of a world safe and secure from emerging infectious disease threats. In 2014, the US government further pledged to work in partnership with at least thirty other countries, encompassing four billion people worldwide, in the next five years, to improve the prevention, detection and response to infectious disease threats.

IV. Efforts to avoid hampering economic or technological development, or international cooperation in the life sciences, including agents and equipment related to biological agents, for peaceful purposes

31. An effective system of national export controls continues to be essential to enhance the avenues of free trade necessary for the implementation of Article X. The U.S. Government's export licensing system is designed to be fast, transparent, and effective in fulfilling our Article III and United Nations Security Council Resolution 1540 obligations and guarding against the risks of proliferation and terrorism. The Department of Commerce's Bureau of Industry and Security (BIS) implements the U.S. Government's export control system for dual-use items, those items that have chiefly commercial uses but that also can be used in conventional arms or weapons of mass destruction (WMD) applications, terrorist activities, or human rights abuses. In August 2010, President Obama announced the foundation of a new export control system designed to strengthen U.S. national security and increase the competitiveness of key U.S. manufacturing and technology sectors by reforming our existing system and adapting it to the changing economic and technological landscape. When completed, this export control reform initiative will result in a single control list, a single licensing agency, a single primary enforcement coordination agency, and a single information technology system.

32. To accomplish its objectives, BIS administers, and amends as necessary, the U.S. Export Administration Regulations. BIS issued licenses for only $8 billion in exported goods in 2013, of the nearly $1.6 trillion in goods exports from the United States in 2013- only 0.005%. Therefore, consistent with our obligations under Article X of the BWC, these regulations have a minimal impact on overall trade.

33. The Department of State's Export Control and Related Border Security (EXBS) Program seeks to prevent the proliferation of weapons of mass destruction (WMD) and irresponsible transfers of conventional weapons by helping to build effective national strategic trade control and border security systems.

34. To achieve this goal, the EXBS Program helps strengthen partner countries' legal authorities and institutional capabilities:

- To regulate trade in sensitive items and prevent transfer authorizations that may contribute to proliferation;
- To target high-risk shipments, detect and interdict illicit trafficking at and between ports of entry, and prosecute violators; and
- To build and sustain a community of policymakers and technical experts committed to implementing effective strategic trade controls.

35. By strengthening authorities and institutional capacities in these critical areas, the EXBS Program helps key partners conform to international standards for regulating trade in items on the control lists of the multilateral export control regimes and meet their obligations pursuant to important international initiatives, including United Nations Security Council Resolution 1540.

36. The EXBS Program engages more than 65 partners worldwide. With 22 in-country advisors and 45 locally hired staff, the EXBS Program supports these partners by implementing more than 250 capacity building and outreach activities each year. Within the United States Government, the EXBS Program coordinates closely with the Department of Defense's International Counter-Proliferation Program; the Department of Energy's International Nonproliferation Export Control Program and Second Line of Defense

Program; and the State Department's Antiterrorism Assistance Program and the Bureau of International Narcotics and Law Enforcement's assistance programmes.

37. Finally, the NIH Office of Biotechnology Activities works to raise awareness of the implications of dual-use research among governments and government entities, the life science research community, and the scientific publishing community. Within the U.S. Government, agencies that have a vested interest in life sciences research coordinate closely in developing approaches that will stimulate such research, while at the same time assuring that potential concerns are assessed and evaluated. The National Science Advisory Board for Biosecurity (NSABB) is a federal advisory committee chartered to provide advice, guidance, and leadership regarding biosecurity oversight of dual-use research; a selection of NIH documents and NSABB recommendations can also be found in the Appendix attached at the end of this report.

V. Case Study: Responding to a Request for Assistance Through the ISU Assistance and Cooperation Database

38. The Implementation Support Unit (ISU) collates and publishes formal requests for and offers of assistance by BWC Parties; in 2012 and 2013, the Government of Iraq requested support through the ISU for a number of activities related to BWC implementation, including biosafety and biosecurity, bioethics, biorisk management policies, bioterrorism risk reduction, and biorisk assessments. The United States Government (USG) responded to this request and has engaged with Iraq to further define its needs and provide assistance focused on supporting the development of self-sustaining facilities and practices. This section summarizes USG assistance in these areas, and primarily covers activities supported by the Department of State's Biosecurity Engagement Program (BEP) and the Department of Defense's Cooperative Biological Engagement Program (CBEP).

Biosafety and Biosecurity (including biosecurity culture)

39. The USG provided assistance to Iraq on biosafety and biosecurity via rapid physical security upgrades and the provision of biorisk management training to life scientists. In 2011, USG engagements provided rapid physical security upgrades to selected government diagnostic laboratories in Baghdad. Scientists from these facilities have also been trained in biorisk management best practices, including secure and safe infectious substance shipping. In 2014, the USG supported a Trainer Development Program, which taught Iraqi laboratorians and researchers how to train others on biorisk management in order to build a self-sustaining system. In providing this support, the USG strives to provide Iraqi partners with international best practice guidelines and standards. Additional biorisk management activities, such as training, workshops and a table-top exercise for government laboratories, are planned for the coming year.

Bioethics

40. The importance of responsible research conduct and a strong awareness of bioethical issues have been highlighted as key issues in biological threat reduction in recent years. In 2013, the USG supported a workshop on bioethics for university professors and students from a number of Iraqi universities. More recently, in 2014, the U.S. National Academy of Sciences invited three Iraqi professors, from universities in Baghdad and Babylon, to participate in one of their internationally-recognized dual-use "Institutes". The objectives of the Institute is for participants to not only learn about dual-use issues, but also gain experience with methods for teaching these topics, have the opportunity to develop their own teaching materials, and learn how to integrate issues of responsible conduct and

bioethics into the existing curricula at their institutions. The Institute was very successful, and a follow-on Institute is planned for 2015 involving additional groups of Iraqi researchers and professors.

Biorisk management policies (including pathogen classification into risk groups)

41. The United States Government (USG)'s most important partner organization in Iraq with respect to biorisk management policy is the Iraq National Biorisk Management Committee (NBMC). The NBMC is comprised of representatives from 15 Iraqi ministries with equities related to biorisk management and is mandated to develop and implement policies to reduce the risk of biological threats. The USG supported the NBMC's first international meeting in Amman, Jordan, in 2013, and later in the year supported a follow-on meeting in Baghdad, which included external consultants at the NBMC's request. During these meetings, the NBMC identified two objectives for immediate priority: development of a national biorisk management policy, which could be further developed into legislation assisting Iraq in demonstrating compliance with the BWC and other international nonproliferation treaties; and the creation of a pathogen control list (based on risk groups) which could be used for import/export control as well as regulation of research on especially dangerous pathogens. At a recent international meeting supported by the USG, with technical support provided by international experts such as VERTIC, the NBMC made significant progress towards meeting these two objectives, and the Committee continues to work closely with the USG as they finalize the draft policy and pathogen list.

Bioterrorism risk reduction

42. Given the threats emanating from conflicts in the region, the USG has responded to Iraqi requests for assistance specifically related to terrorism threats from unconventional weapons, including biological weapons. From a response standpoint, the USG has been working closely with the Iraqi government to develop a national chemical, biological, radiological, and nuclear response plan to include a national biological emergency response plan. These efforts also involve partnership on development of an Emergency Operations Center in the Ministry of Health, to better coordinate response by public health first responders in the event of a biological attack or other biological incident. From a prevention standpoint, in 2013–2014, the USG partnered with several Iraqi ministries and agencies to provide training on chemical detection, investigation, and forensics training, and there are plans to expand these trainings to include biological incident detection and investigation in the coming year.

Biorisk assessment

43. Prior to conducting physical security upgrades at select facilities in Baghdad, experts conducted risk assessments to determine the biosecurity needs and priorities at each facility. In addition, experts have conducted risk assessments at other facilities within Iraq, including several government laboratories in the northern region. Given the access challenges to many parts of the country, the USG has been working with Iraqi partners to explore other methods for conducting risk assessments for laboratories and institutions outside of Baghdad and Erbil. In 2013, the USG awarded a multi-year Biological Threat Reduction Integrating Contract (BTRIC) for work in Iraq. The BTRIC will develop a biosecurity and biosafety baseline which includes identifying current capacities and capabilities to achieving biological security in Iraq; conducting laboratory biosafety and biosecurity assessments; performing rapid security upgrades at provincial laboratories; conducting technical capabilities assessments of laboratory and field staff; building capacity for sample transport; and delivering in-country training to select laboratories. The contractor will coordinate, integrate and implement projects and activities in Iraq in order to enhance biosafety and biosecurity standards and procedures. In 2014–2015, the USG has

plans to initiate a comprehensive risk assessment training program in Iraq, including developing a cadre of Iraqi risk assessment trainers who will continue the implementation of training throughout the country.

V. Conclusion

44. International cooperation and exchange in the life sciences and in combating disease will continue to be a core objective for the United States and is consistent with our obligations under Article X of the Biological Weapons Convention. International cooperation to support the advancement of biological sciences for peaceful purposes; assistance to improve global health through the prevention, detection, and mitigation of disease; and the development of capacity and collaborative opportunities for scientists across the globe are all areas in which the United States will continue to commit programmes and resources. Furtherance of these aims has broad support in all sectors of the United States, including the U.S. Government, non-governmental institutions, industry, the scientific community, civil society, and the American people.

Annex

Training Programmes

Building on the programmes identified in the previous sections of this paper, below are some of the many federal or federally-funded training programmes that conduct work with foreign scientists, including many that are free and open to all. This list is not exhaustive and thus does not include the many additional resources available that have been developed by industry, foundations, academia, or other non-governmental entities.

Online training and educational materials

Emergency Preparedness and Response

The CDC provides resources that are intended to help professionals take an all-hazards approach to preparedness. These materials are available online at: http://emergency.cdc.gov/hazards-all.asp. A list of training resources related specifically to bioterrorism is available online at: http://emergency.cdc.gov/bioterrorism/training.asp.

The Public Health Training Centers Network

This is a distance learning network of people and resources that takes training and information to the learner. A listing of distance learning courses and resources is available online at: http://bhpr.hrsa.gov/grants/publichealth/trainingcenters/index.html

Training and Continuing Education Online (TCEO)

TCEO is a distance learning network that allows participants to register for CDC-managed courses and track their progress online. TCEO is available online at: http://www2a.cdc.gov/TCEOnline/index.asp.

Other learning resources are available online at the CDC Learning Connection Website (http://www.cdc.gov/learning/index.html)

This is a newly established website, designed to help visitors locate public health learning products created by CDC and partners. It features a growing collection of free products in various media formats, including podcasts, e-learning, electronic publications, and live events.

In-person training programmes

The National Biosafety and Biocontainment Training Program (NBBTP)

http://www.nbbtp.org

Emory University - Biosafety Training Course: Biosafety Level 4

This five-day training offers participants the opportunity to learn and practice new skills for BSL4 labs. http://www.sph.emory.edu/CPHPR/biosafetytraining/bsl4.html

University of Texas Medical Branch (UTMB) - National Biocontainment Training Center (NBTC)

This center is dedicated to preparing the worldwide community of infectious disease scientists to work safely in high-containment research laboratories. http://www.utmb.edu/nbtc/

Select Agent Program Training Workshops

The U.S Department of Health and Human Services (HHS) and the U.S. Department of Agriculture (USDA) conduct training workshops to inform individuals of their legal responsibilities for implementing the Select Agent Regulations. The website hosts a collection of past presentations and training webcasts. http://www.selectagents.gov/Training.html

Joint Criminal and Epidemiological Investigation Training Program

The Federal Bureau of Investigation (FBI) and the Centers for Disease Control and Prevention (CDC) jointly developed this program to improve efforts to identify and investigate potential overt or covert biological threats. Initially designed as a domestic program, FBI and CDC have expanded this training to international partner countries.

The Field Epidemiology Training Program (FETP) and the Field Epidemiology and Laboratory Training Program (FELTP)

CDC offers applied epidemiology programmes to help foreign countries develop, set up, and implement dynamic public health strategies to improve and strengthen their public health system and infrastructure. The FE(L)TP programmes include biosafety and bioethics training in support of epidemiological activities. http://www.cdc.gov/globalhealth/fetp/

FBI Synthetic Biology Program

FBI conducts outreach to public and private synthetic biology companies to raise awareness about the potential security risks inherent to the industry, and works with the companies to develop common standards and best practices for risk management. The international component of this program fosters dialogue between international companies and their respective government/law enforcement agencies to develop processes to mitigate the risk of misuse of harmful DNA sequences. They also host academic biosecurity training workshops to promote biosecurity practice.

Additional online resources

The CDC Learning Connection

This site maintains a compendium of free learning products on a wide variety of health issues, including Emergency Management, Infectious Disease, Legal/Ethical Issues, Policy/Planning, Preparedness and Response, and Public Health. http://www.cdc.gov/Features/CDCLearning/

The CDC Online Training Course

This course provides education regarding key principles for securing biological agents in research laboratories and biomedical facilities where loss, theft, release or intentional misuse of the agent might have significant public health or economic consequences.

http://www.cdc.gov/biosafety/biosecuritytraining/page1024.html

The FDA's Food Defense and Emergency Response-Training

The U.S. Food and Drug Administration (FDA) works with other government agencies and private sector organizations to help reduce the risk of tampering or other malicious, criminal, or terrorist actions on the food and cosmetic supply. Web-based training and additional educational resources are available at: http://www.fda.gov/Food/FoodDefense/default.htm

Facility Inspection videos (BSL-3/toxins laboratories)

These informational videos are for entities or individuals who currently possess, store, or transfer select agents and toxins and those who are planning to begin work with select agents or toxins. http://www.selectagents.gov/FIV.html

Global Biorisk Management Curriculum Development (GBRMC)

CBEP has developed and is implementing a biorisk management curriculum to address biosafety and biosecurity training. Users of the training materials can participate in a virtual network of trainers via a web-based portal, and provide lessons learned, updates, and feedback for the continual improvement of the materials. The network of trainers currently consists of more than 100 biosafety professionals active in the United States, Europe, Asia, and Africa.

The Executive Office of the President, Office of Science and Technology Policy website

This site provides information to the public, academic and private sector research communities about government policies related to the safe and secure conduct of biological research and the technologies arising out of the application of the life sciences. http://www.whitehouse.gov/administration/eop/ostp/nstc/biosecurity

The S3 (Science, Safety, and Security) website

This website provides information on biosafety, biosecurity, biocontainment, and biorisk management. http://www.phe.gov/s3/Pages/default.aspx

NIH Dual-Use Research video

http://osp.od.nih.gov/office-biotechnology-activities/biosecurity/dual-use-research-of-concern/dialogue

NIH-Dual-Use Education al Materials

http://osp.od.nih.gov/office-biotechnology-activities/biosecurity/dual-use-research-concern

NSABB Oversight Framework Report: Proposed Framework for the Oversight of Dual Use Life Sciences Research

Strategies for Minimizing the Potential Misuse of Research Information:

http://osp.od.nih.gov/office-biotechnology-activities/biosecurity/nsabb

Biological Risk Management and Nonproliferation website

The Department of Health and Human Services (HHS), Office of the Assistant Secretary for Preparedness and Response (ASPR), established this website to increase awareness of the BWC and UN Security Council Resolution 1540. http://www.phe.gov/about/OPP/Pages/bwc.aspx

The Department of Commerce, Chemical and Biological Controls Division

The Chemical and Biological Controls Division (CBC) is the focal point within the United States Government (USG) for implementing dual-use export controls for biological (CB) equipment, materials and technology (e.g., toxins, pathogens, fermenters). These export controls are in place biological weapons concerns and to prevent the diversion of such items to destinations and end-users of concern. http://www.bis.doc.gov/index.php/policy-guidance/product-guidance/chemical-and-biological-controls

Meeting of the States Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction

8 August 2014

English/French/Spanish only

2014 Meeting
Geneva, 1-5 December 2014

Meeting of Experts
Geneva, 4-8 August 2014

List of participants

A. States Parties

Algeria

M. Boudjemâa Delmi	Ambassadeur, Représentant permanent, Genève Chef de délégation
M. Hamza Khelif	Ministre conseiller, Mission permanente, Genève
M. Mohamed Amine Abdouni	Commandant maître assistant hospitalo-universitaire en microbiologie, Ministère de la défense nationale
M. Nader Louafi	Premier Secrétaire, Mission permanente, Genève
M. Mohamed Lakehal	Attaché des affaires étrangères, Ministère des affaires étrangères

Argentina

Sr. Julio Mercado	Consejero, Misión Permanente, Ginebra
Sr. Mariano Álvarez Wagner	Secretario
Sra. Adriana Bernacchi	Dra., Instituto de Investigaciones Científicas y Técnicas para la Defensa

GE.14-11227 (E)
1411227

Please recycle

	(CITEDEF), Ministerio de Defensa
Sra. Miriam Mariella	Dra., Bioquímica, Estado Mayor General del Ejército, Dirección General de Investigación y Desarrollo, Ministerio de Defensa

Australia

Mr. Ian McConville	Counsellor and Deputy Permanent Representative to the Conference on Disarmament, Geneva
Ms. Louise Abbott	Executive Assistant to the Ambassador, Permanent Mission, Geneva

Austria

Mr. Karl Prummer	Minister, Deputy Permanent Representative, Permanent Mission, Geneva Head of Delegation
Ms. Caroline Wörgötter	Counsellor, Permanent Mission, Geneva Deputy Head of Delegation
Mr. Peter Steiner	Col., Counsellor (Military Affairs), Permanent Mission, Geneva

Bahrain

Mr. Fahad Albaker	First Secretary, Permanent Mission, Geneva

Belarus

Mr. Alexander Opimakh	Deputy Permanent Representative Head of Delegation
Mr. Ivan Grinevich	Counsellor, Permanent Mission Deputy Head of Delegation
Mr. Nikolai Ovsyanko	Counsellor, International Security and Arms Control Department, Ministry of Foreign Affairs

Belgium

M. Bertrand de Crombrugghe de Picquendaele	Ambassadeur, Représentant permanent, Genève Chef de délégation
M. Dirk Dons	Commandant, Conseiller, Pharmacien biologiste, Ministère de la Défense

Benin

M. Séraphin Lissassi	Ambassadeur, Représentant permanent, Genève
M. Eloi Laourou	Ambassadeur, Représentant permanent adjoint, Genève
Mme Fernande A. Houngbedji	Ambassadeur, Directrice des organisations internationales, Ministère des affaires étrangères, Intégration africaine, de la francophonie et des Béninois de l'extérieur
Mme Marie-Claire Ouorou Guiwa	Ministre conseiller, Mission permanente, Genève
Mme Mireille Joselyne Tomety	Attachée, Mission permanente, Genève

Brazil

Mr. Pedro Motta Pinto Coelho	Ambassador, Permanent Representative to the Conference on Disarmament Head of Delegation
Mr. Neil Giovanni Paiva Benevides	Minister, Permanent Representation to the Conference on Disarmament, Geneva
Mr. João Carlos Vilela Morgero	General, Military Advisor, Permanent Representation to the Conference on Disarmament, Geneva
Mr. Marcio Augusto dos Anjos	Second Secretary, Permanent Representation to the Conference on Disarmament, Geneva

Mr. Carlos Guilherme Sampaio Fernandes	Third Secretary, Permanent Representation to the Conference on Disarmament, Geneva
Mr. Geraldo Corrêa de Lyra Júnior	Colonel, Assistant Military Advisor, Permanent Representation to the Conference on Disarmament, Geneva
Mr. Newton Soares Santarossa	Colonel, Manager of Sensitive Technologies Division, Ministry of Defense
Mr. Guilherme Guimarães Ferreira	Major, Assistant Military Advisor, Permanent Representation to the Conference on Disarmament, Geneva
Ms. Nádia Vaez Gonçalves da Cruz	Captain, Pharmaceutical Officer, Ministry of Defense
Ms. Sandra Ceciliano de Souza Veloso	Science and Technology Analyst, Coordination-General of Sensitive Items, Ministry of Science Technology and Innovation
Ms. Irene Zasimowicz Pinto Calaça	Outreach Analyst, Intelligence Agency (ABIN)

Bulgaria

Mr. Ivan Piperkov	Ambassador and Permanent Representative, Permanent Mission, Geneva Head of Delegation
Ms. Boyana Trifonova	First Secretary, Permanent Mission, Geneva

Burkina Faso

M. Prosper Vokouma	Ambassadeur, Représentant permanent, Genève Chef de délégation
Mme Evelyne M. A. Ilboudo	Ambassadeur, Représentant permanent adjoint, Genève

Canada

Ms. Elissa Golberg	Ambassador and Permanent Representative, Permanent Mission to the United Nations and the Conference on Disarmament, Geneva Head of Delegation
Ms. Chrystiane Roy	Deputy Director, Non-Proliferation and Disarmament Division, Department of Foreign Affairs, Trade and Development Alternate Head of Delegation
Ms. Kelly Anderson	Counsellor, Deputy Permanent Representative, Permanent Mission to the United Nations and the Conference on Disarmament, Geneva
Mr. Trevor Smith	Senior Program Manager and Deputy Director, Global Partnership Program, Department of Foreign Affairs, Trade and Development
Mr. John Griffin	Program Officer, Global Partnership Program, Department of Foreign Affairs, Trade and Development
Mr. Christopher Andrew Halliday	Biological Weapons Policy Analyst, Non-Proliferation and Disarmament Division, Department of Foreign Affairs, Trade and Development
Ms. Jeannette Macey	Manager, Exposure Reporting Program, Centre for Biosecurity, Public Health Agency of Canada
Ms. Stacey Mantha	Director, Office of Pathogen Security, Centre for Biosecurity, Public Health Agency of Canada

Chile

Sra. Marta Maurás	Embajadora, Representante Permanente, Misión Permanente, Ginebra Jefe de Delegación
Sr. Victor Molina	Subdirector General de Movilización Nacional, Dirección General de Movilización Nacional
Sra, Marisol O'Ryan	Jefe, Sección Convención Armas Biológicas, Dirección General de Movilización Nacional
Sra. Ximena Urra	Sección Material de Uso Bélico, Dirección General de Movilización Nacional
Sr. Fernando Guzmán	Tercer Secretario, Misión Permanente, Ginebra

China

Mr. Shen Jian	Counsellor, Permanent Mission, Geneva Head of Delegation
Ms. Wang Qian	Deputy Director, Ministry of Foreign Affairs
Mr. Lu Difan	Attaché, Ministry of Foreign Affairs
Mr. Wang Haitao	Official, Ministry of Defense
Mr. Jin Jun	Official, Ministry of Defense
Ms. Wang Jinmei	Expert, Ministry of Defense
Mr. Sun Yangong	Expert, Ministry of Defense
Mr. Yu Zunbo	Official, Institute of Veterinary Drugs Control
Mr. Han Yuhong	Official, Health Emergency Division, National Health and Family Planning Commission
Ms. Xu Wenli	Third Secretary, Permanent Mission, Geneva

Colombia

Mr. Juan José Quintana	Ambassador, Permanent Representative, Permanent Mission, Geneva Head of Delegation
Mr. Mauricio Beltrán Durán	Director, Public Health Networks, National Institute of Health
Mr. José Roberto Galindo Álvarez	Technical Director, Agricultural Products, Agricultural Institute
Mr. Francisco Alberto González	Minister Counsellor, Permanent Mission, Geneva
Ms. Heidi Liliana Botero	First Secretary, Permanent Mission, Geneva

Cuba

Mr. Yusnier Romero Puentes	First Secretary, Permanent Mission, Geneva
Ms. Yumirka Fernández Palacios	Second Secretary, Permanent Mission, Geneva
Ms. Lilianne Sánchez Rodríguez	Third Secretary, Permanent Mission, Geneva

Cyprus

Mr. George S. Yiangou	Chargé d'affaires a.i., Permanent Mission, Geneva
Ms. Theodosia Pantazi	Attaché, Permanent Mission, Geneva

Czech Republic

Ms. Markéta Homolková	First Secretary, Permanent Mission, Geneva
Ms. Hana Kubátová	Inspector, Department of Non-proliferation, States Office for Nuclear Safety
Mr. Jan Kynčl	Medical epidemiologist, National Institute of Public Health, Ministry of Health

Denmark

Mr. Jacob Buchwaldt-Nissen	Director, Policy division, Centre for Biosecurity and Biopreparedness

Ecuador

Sr. Alfonso Morales	Embajador, Representante Permanente Alterno, Encargado de Negocios a.i., Misión Permanente, Ginebra
Sr. León Pablo Avilés	Ministro, Misión Permanente, Ginebra
Sr. Marcelo Murillo	Teniente Coronel, Ministerio de Defensa Nacional

El Salvador

Sr. Félix Ulloa	Ministro Consejero, Misión Permanente, Ginebra

Estonia

Ms. Riia Salsa-Audiffren	Second Secretary, Permanent Mission, Geneva

Ethiopia

Mr. Degemu Shertaga Maruta	Minister Counsellor, Permanent Mission, Geneva

Finland

Mr. Jyri Järviaho	Minister-Counsellor, Permanent Mission, Geneva
Ms. Susanna Sissonen	Senior Specialist, National Institute for Health and Welfare, THL

France

M. Jean-Hughes Simon-Michel	Ambassadeur, Représentant permanent auprès de la Conférence du désarmement Chef de délégation

M. Erwan Roche	Capitaine de vaisseau, Conseiller militaire, Représentation permanente auprès de la Conférence du désarmement
Mme Marie-Gaëlle Robles	Conseiller, Représentation permanente auprès de la Conférence du désarmement
Mme Anaïs Laigle	Premier secrétaire, Représentation permanente auprès de la Conférence du désarmement
Mme Tiphaine Jouffroy	Sous-direction du contrôle des armements et de l'Organisation de la sécurité et de la coopération en Europe, Directions des affaires stratégiques, de sécurité et du désarmement, Ministère des affaires étrangères
Mme Julie Boumrar	Délégation aux affaires stratégiques, ministère de la défense
Mme Juliette Raimbault	Délégation aux affaires stratégiques, ministère de la défense
M. Christophe Genisset	Expert

Gabon

M. René-Bertrand N'no Minlaghe	Ambassadeur, Directeur des organisations internationales

Georgia

Mr. Irakli Jgenti	Chargé d'affaires, Permanent Mission, Geneva Head of Delegation
Ms. Lela Bakanidze	Professor, Ph.D, RBP, Agrarian University, Non-Proliferation programmes Manager, President Bio-safety Association
Mr. Shalva Burduli	Head, New Threats and Arms Control Division, department for Security Policy and Euro-Atlantic Integration, Ministry of Foreign Affairs

Germany

Mr. Volker Böhm	Deputy Permanent Representative to the Conference on Disarmament, Geneva Head of Delegation
Mr. Peter Beerwerth	Head, Biological Weapons Division, Federal Foreign Office, Berlin
Mr. Peter Pauels	Col. (GS), Military Adviser, Permanent Representation to the Conference on Disarmament
Mr. Thomas Müller-Färber	Desk Officer, Biological Weapons Division, Federal Foreign Office, Berlin
Mr. Ralph Dieter Knauf	LTC, Federal Armed Forces Verification Centre, Geilenkirchen
Mr. Walter Biederbick	Dr., Partnership Programme for Excellence in Biological and Health Security
Mr. Stephan Günter	Prof., Dr., Bernhard-Nocht-Institute for Tropical Medecine
Ms. Christine Uhlenhaut	Dr., Robert-Koch-Institute, Unit for strengthening Global Biosecurity
Ms. Sylvia Worbs	Dr., Robert-Koch-Institute, Centre for Biological Threats and Special Pathogens

Greece

Mr. Ioannis Mallikourtis	Counsellor, Permanent Mission, Geneva

Guatemala

Sr. Francisco Villagrán de León	Embajador, Representante Permanente, Misión Permanente, Ginebra Jefe de Delegación
Sra. Ana Regina Toledo	Tercer Secretario, Misión Permanente, Ginebra

Holy See

Mr. Silvano Tomasi	Archevêque, Nonce apostolique, Représentant permanent, Mission permanente, Genève Chef de délégation
M. Richard Allen Gyhra	Mgr., secrétaire, Mission permanente, Genève
M. Antoine Abi Ghanem	Attaché, Mission permanente, Genève
M. Stefano Saldi	Stagiaire, Mission permanente, Genève

Hungary

Ms. Judit Körömi	Special Representative, Foreign Minister for Arms Control, Disarmament and Non-proliferation, Ministry of Foreign Affairs Head of Delegation
Mr. Márk Horváth	Counsellor, Deputy Permanent Representative, Permanent Mission, Geneva
Mr. Dávid Pusztai	Second Secretary, Permanent Mission, Geneva
Mr. László Csutorás	Expert, Trade Licensing Office

India

Mr. D. B. Venkatesh Varma	Ambassador, Permanent Representative to the Conference on Disarmament, Permanent Mission, Geneva Head of Delegation
Mr. Siddhartha Nath	First Secretary (Disarmament) Permanent Mission, Geneva
Mr. Chinmoy Naik	Deputy Secretary (D&ISA), Ministry of External Affairs, New Delhi
Mr. M. M. Parida	Dr., Scientist, Defence Research and Development Establishment, Gwalior

Mr. P.K. Chakrabarty	Dr., Assistant Director General (Plant Protection) Council of Agricultural Research, New Delhi

Indonesia

Mr. Triyono Wibowo	Ambassador, Permanent Representative, Permanent Mission, Geneva Head of Delegation
Mr. Edi Yusup	Ambassador, Deputy Permanent Representative, Permanent Mission, Geneva
Ms. Nina S. Djajaprawira	Minister Counsellor, Permanent Mission, Geneva
Ms. Lynda K. Wardhani	First Secretary, Permanent Mission, Geneva
Mr. Gerry Indradi	Third Secretary, Permanent Mission, Geneva

Iran (Islamic Republic of)

Mr. Mohsen Naziri Asl	Ambassador, Permanent Representative, Permanent Mission, Geneva Head of Delegation
Mr. Mohammad Kazem Asayesh Talab Tousi	First Secretary, Permanent Mission, Geneva
Mr. Kayhan Azadmanesh	Head, Virology Department, Pasteur Institute
Mr. Seyed Ahmad Mirzaei	Adviser, Ministry of Defence, Tehran
Mr. Abbas Khan Ahmadi	Adviser, Ministry of Defence, Tehran

Iraq

Mr. Senan Abd Al-Hassan Muhi	Director, Biology Department, National Monitoring Directorate
Mr. Mahdi Falih Hassan Al-Jewari	Head, Biological Weapons Convention Section, National Monitoring Directorate, Ministry of Science and Technology

Mr. Anas Abdullateef Mohi	Second Secretary, Permanent Mission, Geneva

Ireland

Mr. Robert Jackson	Deputy Permanent Representative to the Conference on Disarmament, Permanent Representation, Geneva Head of Delegation
Mr. Ronald Russell	Professor, Lecturer, Adviser, Moyne Institute of Preventative Medicine, Trinity College, Dublin

Italy

Mr. Vinicio Matí	Ambassador, Permanent Representative to the Conference on Disarmament, Geneva Head of Delegation
Mr. Tiberio Schmidlin	Deputy Permanent Representative to the Conference on Disarmament, Geneva
Ms. Roberta Ballabio	Expert, Centre for Scientific Culture Alessandro Volta
Ms. Silvana De Candia	Expert, Presidency of the Council of Ministers
Mr. Antonio Fasanella	Expert, Experimental Zooprophylactic Institute of Apulia and Basilicata
Ms. Maria Rita Gismondo	Prof., Expert, Luigi Sacco University Hospital
Mr. Maurizio Martellini	Prof., Expert, Centre for Scientific Culture Alessandro Volta
Mr. Mario Amadei	Brigadier General, Expert
Ms. Francesca Cerutti	Expert

Japan

Mr. Toshio Sano	Ambassador Extraordinary and Plenipotentiary, Head of Delegation to the Conference of Disarmament, Geneva Head of Delegation
Mr. Hiroyuki Yamamoto	Minister, Delegation to the Conference on Disarmament, Geneva
Mr. Tomoya Saito	Dr., Chief Senior Researcher, Department of Health Crisis Management, National Institute of Public Health
Mr. Chihiro Mochizuki	First Secretary, Delegation to the Conference on Disarmament, Geneva
Ms. Naomi Takahashi	Official, Biological and Chemical Weapons Conventions Division, Disarmament and Non-proliferation and Science Department, ministry of Foreign Affairs, Tokyo
Ms. Nana Watanabe	Adviser for Disarmament Affairs, Delegation to the Conference on Disarmament, Geneva

Jordan

Mr. Rajab M. Sukayri	Dr., Ambassador, Permanent Representative, Permanent Mission, Geneva Head of Delegation
Mr. Asem Ababneh	Counsellor, Permanent Mission, Geneva
Mr. Hamza Ma'aitah	Third Secretary, Permanent Mission, Geneva

Kenya

Ms. Roselida Owuor	Senior Science Secretary, Alternate National Contact Person of BTWC Head of Delegation

Ms. Lyindah Makayoto	Dr., Medical/Epidemiologist, Disease Surveillance and Response Unit, Ministry of Health

Kuwait

Mr. M. Jamal Al Ghunaim	Ambassador, Permanent Mission, Geneva
Ms. Rania Al Mulaifi	Diplomatic Attaché, Permanent Mission, Geneva

Lao People's Democratic Republic

Mr. Vilatsone Visonnavong	Deputy Director, United Nations Political and Security Affairs Division, Department of International Organizations, Ministry of Foreign Affairs
Mr. Losoualiene Xiaying	Third Secretary, Permanent Mission, Geneva

Latvia

Ms. Diāna Kazina	Advisor, Human Rights and Disarmament, Permanent Mission, Geneva

Libya

Mr. Mustafa Salem	Counsellor, Permanent Mission, Geneva

Lithuania

Mr. Rytis Paulauskas	Ambassador, Permanent Representative, Permanent Mission, Geneva
Ms. Birute Abraitiene	Minister Counsellor, Permanent Mission, Geneva

Madagascar

Mme Harifera Elisa Rabemananjara	Conseiller, Mission permanente, Genève

Malaysia

Mr. Shaharuddin Onn	Deputy Permanent Representative, Permanent Mission, Geneva
Mr. Azril Abd. Aziz	Principal Assistant Secretary, Multilateral Security Division, Ministry of Foreign Affairs
Ms. Zalini Yunus	Dr., Head of Human Factors, Protection and Biophysical Technology Division, Science and Technology Research Institute for Defence (STRIDE), Ministry of Defence
Ms. T.S. Saraswathy Subramaniam	Research Officer, Institute for Medical Research (IMR), Ministry of Health
Mr. Amri Bukhairi Bakhtiar	Counsellor, Permanent Mission, Geneva

Malta

Mr. John Paul Grech	Ambassador, Permanent Representative, Dr., Permanent Mission, Geneva
Mr. Mark Ciscaldi	First Secretary, Permanent Mission, Geneva

Mexico

Sr. Jorge Lomónaco	Embajador, Representante Permanente, Misión Permanente, Ginebra Jefe de Delegación
Sr. Raúl Heredia	Embajador, Representante Permanente Alterno, Misión Permanente, Ginebra jefe de Delegación Alterno
Sr. Christian Arturo Zaragoza Jiménez	Dr., Subdirector de Prevención de Cólera, Dirección de Urgencias Epidemiológicas y Desastres, Centro Nacional de Programas Preventivos y Control de Enfermedades, Secretaria de Salud
Sra. Sandra Paola Ramírez Valenzuela	Segunda Secretaria, Misión Permanente, Ginebra

Sra. Liliana Padilla Rodríguez	Segunda Secretaria, Misión Permanente, Ginebra
Sra. Elizabeth Chavolla Sánchez	Misión Permanente, Ginebra

Mongolia

Mr. Gozon Jargalsaikhan	Deputy Permanent Representative and Minister-Counsellor, Permanent Mission, Geneva
Ms. Namkhaidorj Oyunbileg	Specialist for Emergency Related Issues, Implementing Agency for Veterinary and Animal Breeding

Morocco

M. Mohamed Benmassaoud	Colonel
M. Salah Eddine Taouis	Conseiller, Mission permanente, Genève

Netherlands

Mr. Henk Cor van der Kwast	Disarmament Ambassador at Large, Permanent Representative to the Conference on Disarmament, Geneva Head of Delegation
Mr. Rik Bleijs	Acting Head, Biosecurity Office, National Institute for Public Health and the Environment, Bilthoven
Ms. Linda van den Berg	Scientific Adviser, National Institute for Public Health and the Environment, Bilthoven
Mr. Koos van der Bruggen	Secretary Biosecurity Issues, Royal Academy of Arts and Science (KNAW), Amsterdam
Mr. Ayse Aydin	Policy Adviser, Ministry of Foreign Affairs, Non-proliferation and Disarmament Division, The Hague
Mr. Bob Ent	Crisis Management and CBRN-security, Ministry of Economic Affairs, Innovation and Agriculture, The Hague

Mr. Mark Versteden	First Secretary, Deputy Head of the Delegation to the Conference on Disarmament, Geneva
Ms. Esther Visser	Assistant, Delegation to the Conference on Disarmament, Geneva

New Zealand

Mr. Joseph Ballard	Deputy Permanent Representative to the Conference on Disarmament, Geneva Head of Delegation

Nigeria

Mr. Albert Gyang Bot	Deputy Director Armament, Headquarters Air Force

Norway

Ms. Åshild Kjøk	Senior Adviser, Ministry of Foreign Affairs, Oslo Head of Delegation
Ms. Malgorzata T. Hauge	First Secretary, Permanent Mission, Geneva
Mr. Olaf Scheel	head, Armed Forces Institute of Biology, Oslo

Oman

Mr. Hamed Sulaiman Hamed Al-Bartumani	Lieutenant Colonel, Ministry of Defence

Pakistan

Mr. Zamir Akram	Ambassador and Permanent Representative, Permanent Mission, Geneva
Mr. Aamar Aftab Qureshi	Deputy Permanent Representative, Permanent Mission, Geneva
Mr. Usman Iqbal Jadoon	First Secretary, Permanent Mission, Geneva

Mr. Irfan Mahmood Bokhari	Second Secretary, Permanent Mission, Geneva

Panama

Sr. Alejandrol. Mendoza Gantes	Encargado de negocios, a.i., Misión Permanente, Ginebra

Peru

Sr. Luis Enrique Chávez Basagoitia	Embajador, Representante Permanente, Misión Permanente, Ginebra Jefe de Delegación
Sra. María Antonia Masana García	Ministro, Representante Permanente Alterno, Misión Permanente, Ginebra
Sra. Claudia Portillo González	Segunda Secretaria, Misión Permanente, Ginebra

Philippines

Ms. Cecilia B. Rebong	Permanent Representative, Permanent Mission, Geneva Head of Delegation
Ms. Noralyn Jubaira-Baja	Deputy Permanent Representative, Permanent Mission, Geneva
Ms. Hossana P. Dela Cruz	Attaché, Permanent Mission, Geneva

Poland

Mr. Remigiusz Henczel	Ambassador, Permanent Representative, Permanent Mission, Geneva Head of Delegation
Mr. Wojciech Flera	Minister Counsellor, Deputy Permanent Representative, Permanent Mission, Geneva
Mr. Ryszard Slomski	Prof., Vice-Director, Institute of Human Genetics, Polish Academy of Sciences
Ms. Maja Kosieradzka	Minister's Counsellor, Ministry of Environment
Mr. Zbigniew Ciolek	Colonel, Counsellor, Permanent Mission, Geneva

Mr. Grzegorz Graniak	Dr., Military Institute of Hygiene and Epidemiology, Ministry of National Defense
Ms. Joanna Rybak	Senior Specialist, Forestry and Environment Protection Department, Ministry of Environment
Ms. Malgorzata Giza	Specialist, Economical Security Department, Ministry of Economy

Portugal

Mr. Carlos Penha Gonçalves	Colonel, Expert, Ministry of Defence, Lisbon
Ms. Sofia Núncio	Expert, Instituto Nacional de Saúde Doutor Ricardo Jorge, Lisbon
Mr. Nuno Cabral	First Secretary, Permanent Mission, Geneva

Qatar

Mr. Nasser Ali Al-Ansari	Dr., Member, National Committee for the Prohibition of Weapons, Hamad Corporation's Representative
Mr. Ali Rashid Al-Muhannadi	1st Lieutenant, National Committee for the Prohibition of Weapons
Ms. Noof Ahmed Al-Thani	National Committee for the Prohibition of Weapons

Republic of Korea

Mr. Ahn Young-jip	Ambassador, Deputy Permanent Representative, Permanent Mission, Geneva Head of Delegation
Ms. Huh Yoon-jeong	Second Secretary, Permanent Mission, Geneva
Mr. Park Heon-wook	Defense Attaché, Embassy, Bern
Mr. Lee Hei-Chan	Professor, Department of Pharmaceutical Engineering, Sun Moon University

Mr. Kim Jong-min	Manager, BWC Implementation Team, Biotechnology Industry Organization
Ms. Lee Dong-ju	Staff, Embassy, Bern

Russian Federation

Mr. Vladimir Yermakov	Deputy Director, Ministry of Foreign Affairs Head of Delegation
Mr. Vladimir Ladanov	Counsellor, Ministry of Foreign Affairs Deputy Head of Delegation
Mr. Artur Balaov	Executive Secretary of the Delegation, Attaché, Ministry of Foreign Affairs
Mr. Victor Kholstov	Ministry for Industry and Trade
Mr. Kirill Mikhailov	Ministry of Defense
Mr. Oleg Kochanov	Ministry of Defense
Mr. Sergey Kuznetsov	Ministry of Defense
Mr. Vyacheslav Smolenskiy	Federal Service for Surveillance on Consumer Rights Protection and Human Well-Being
Ms. Yulia Demina	Federal Service for Surveillance on Consumer Rights Protection and Human Well-Being
Mr. Yury Rusakov	Ministry for Agriculture
Mr. Yury Levadnyy	Federal Medical Biological Agency
Mr. Vladimir Serkov	Expert, Ministry for Industry and Trade
Mr. Alexey Zvarich	Expert, Ministry of Healthcare
Ms. Aryuna Dashitsyrenova	Expert, Ministry of Health
Ms. Svetlana Desvyannikova	Ministry of Agriculture
Mr. Alexander Korotin	Expert, Ministry of Foreign Affairs
Mr. Evgeny Bragin	Expert, Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing
Mr. Dmitry Efremenko	Expert, Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing

Mr. Valentin Safronov	Expert Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing
Mr. Alexander Chikin	Interpreter, Counsellor, Ministry of Foreign Affairs

Saudi Arabia

Mr. Emad Mohammed Altaf	Dr., Brig.-General, Ministry of Interior
Mr. Habeeb bin Mohammed Abdelsamad	Eng., Ministry of Trading
Mr. Mohammed Al Julaifi	Dr., Ministry of Agriculture
Mr. Ahmed Omar-Al Sobael	Staff Colonel, Ministry of Defence
Mr. Abdul Rahman bin mohammed Al-Ghofaili	Lieutenant Colonel Eng., Ministry of Defence
Mr. Sami bin Mohammed Al-Alaian	Major, Ministry of Defence
Mr. Tarek Al-Arnoos	Dr., Director General of Emergency Services, Ministry of Health

Serbia

Ms. Dragana Mladenović-Nestorović	Second Secretary, Permanent Mission, Geneva

Singapore

Mr. Steven pang Chee Wee	Chargé d'affaires a.i., Deputy Permanent Representative, Permanent Mission, Geneva
Ms. Joy Boo	First Secretary, Permanent Mission, Geneva

Slovakia

Mr. Fedor Rosocha	Ambassador Extraordinary and Plenipotentiary, Permanent Representative, Permanent Mission, Geneva
Mr. Ján Plavčan	Second Secretary, Permanent Mission, Geneva
Mr. Cyril Klement	Ministry of Health

Mr. Dominik Hatiar	Intern, Permanent Mission, Geneva

South Africa

Mr. Abdul Samad Minty	Ambassador Extraordinary and Plenipotentiary, Permanent Mission, Geneva Head of Delegation
Ms. Ncumisa Pamela Notutela	Deputy Permanent Representative, Permanent Mission, Geneva Alternate Head of Delegation
Ms. Simbongile Mancotywa-Kumsha	Counsellor, Permanent Mission, Geneva
Mr. Livhuani Masindi	Technical Expert, Pretoria
Mr. Bennie Steyn	Dr., Technical Expert, South African Council for the Non-Proliferation of Weapons of Mass Destruction, Pretoria
Mr. Siphiwo Ngqukuvana	Technical Expert, Pretoria
Ms. Lebogang Phihlela	Non-Proliferation Secretariat, Department of Trade and Industry, Pretoria
Mr. Hendrik Erasmus	Technical Expert, Pretoria
Ms. Bronwen Levy	First Secretary, Disarmament, Permanent Mission, Geneva
Ms. Kershney Chantelle naidoo	First Secretary, Disarmament, Permanent Mission, Geneva

Spain

Sr. Julio Herráiz	Embajador ante la Conferencia de Desarme, Ginebra
Sr. Rafael Pérez Mellado	Asesor Científico para cuestiones de no proliferación biológica, Subdirección General de No Proliferación y Desarme, Ministerio de Asuntos Exteriores, Madrid
Sr. Rafael Górgolas	Consejero, Representación Permanente, Ginebra
Sra. Fátima García Montero	Dirección General de Policía, Ministerio del Interior, Madrid

Sri Lanka

Ms. Manisha Gunasekara	Deputy permanent Representative, Permanent Mission, Geneva
Mr. Chatura Perera	Second Secretary, Permanent Mission, Geneva

Sweden

Mr. Ulf Lindell	Minister-Counsellor, Permanent Mission, Geneva Head of Delegation
Mr. Jan Lodding	Deputy Director, Disarmament and Non-Proliferation, Ministry of Foreign Affairs, Stockholm
Ms. Elisabet Frihz	Defence Research Agency (FOI)
Ms. Susanne Borjegren	Defence Research Agency (FOI)

Switzerland

M. Urs Schmid	Ambassadeur, Représentant permanent auprès de la Conférence du désarmement, Mission permanente, Genève Chef de délégation
M. Laurent Masmejean	Conseiller, Mission permanente, Genève
M. Sergio Bonin	Collaborateur scientifique, Section maîtrise des armements de désarmement, Division politique de sécurité, Département fédéral des affaires étrangères
M. Piers D. Millet	Dr., Expert, Mission permanente, Genève
M. Vincent Choffat	Dr., Expert, relations internationales défense, Département fédéral de la défense, de la protection et des sports

M. Cédric Invernizzi	Dr., Expert, Contrôle de l'armement NRBC, Laboratoire Spiez, Office fédérale de la protection de la population, Département fédéral de la défense, de la protection et des sports
Mme Mélanie Gerber	Expert, Politique de contrôle à l'exportation, secrétariat d'État à l'économie, Département fédéral de l'économie, de la formation et de la recherche
Mme Kerry Amhof	Expert, Politique de contrôle à l'exportation, secrétariat d'État à l'économie, Département fédéral de l'économie, de la formation et de la recherche

Thailand

Mr. Natapanu Nopakun	Minister Counsellor, Permanent Mission, Geneva
Ms. Juthamas Siripanee	Medical Technologist (Senior Professional Level) Department of Medical Sciences, Ministry of Public

Turkey

Ms. Berna Kasnakli	Counsellor, Permanent Mission, Geneva
Mr. Ramazan Ercan	Counsellor (Disarmament), Permanent Mission, Geneva
Mr. Erol Erçağ	Prof., Dr., Istanbul University
Mr. Erhan Akçay	Dr., Ministry of Food, Agriculture and Livestock

Ukraine

Mr. Yurii Klymendo	Ambassador Extraordinary and Plenipotentiary, Permanent Mission, Geneva Head of Delegation

Mr. Sehiy Komisarendo	Prof., Ambassador Extraordinary and Plenipotentiary, academician-secretary, Department of Biochemistry, Physiology and Molecular Biology, National Academy of Science Deputy Head of Delegation
Mr. Denys Demchenko	First Secretary, Permanent Mission, Geneva
Mr. Volodymyr kovalyshyn	Third Secretary, Permanent Mission, Geneva

United Arab Emirates

Mr. Mohamed Al Matrooshi	Armed Forces
Mr. Saif Al Kaabi	Armed Forces
Mr. Sultan Al Kaabi	Armed Forces
Mr. Saeed Al Mehrezi	Committee for Goods and Materials Subject to Import and Export Control
Mr. Abdulatif Fakhfakh	Expert in International Organizations, Permanent Mission, Geneva

United Kingdom of Great Britain and Northern Ireland

Mr. Matthew Rowland	Ambassador, Permanent Representative to the Conference on Disarmament, Geneva Head of Delegation
Mr. John Walker	Dr., Arms Control and Disarmament Research Unit, Foreign and Commonwealth Office
Ms. Lorna Miller	Dr., Defence Science and Technology Laboratory
Mr. James Harrison	Ministry of Defence
Mr. Mike Amsden	Ministry of Defence
Ms. Caroline Hawkyard (née Redmond)	Dr., Defence Science and Technology Laboratory
Ms. Carol Stone	Dr., Defence, Science and Technology Laboratory

Mr. David Elliot	Defence, Science and Technology Laboratory

United States of America

Mr. Christopher L. Buck	Acting Permanent Representative to the Conference on Disarmament and Special Representative for Biological and Toxin Weapons Convention Issues, Geneva Representative, Head of Delegation
Mr. Scott Davis	Deputy Director, Biological Policy Staff, Bureau of International Security and Non-Proliferation, Department of State, Washington D.C. Deputy Representative
Ms. Kristine L. Pelz	Acting Deputy Permanent Representative, Permanent Delegation to the Conference on Disarmament, Geneva Alternate Representative
Mr. John Bergemann	Senior Advisor, Permanent Delegation to the Conference on Disarmament, Geneva
Ms. Bonnie Jenkins	Ambassador, Coordinator for Global Partnership, Bureau of International Security and Non-Proliferation, Department of State, Washington D.C.
Ms. Meg L. Flanagan	Dr., Microbiologist, Biological Policy Staff, Bureau of International Security and Non-Proliferation, Department of State, Washington D.C.
Ms. Rebecca Katz	Dr., Public Health Consultant, Bureau of International Security and Non-Proliferation, Department of State, Washington D.C.
Ms. Tanya Anthony	Biologist, Bureau of Arms Control, Verification and Compliance, Department of State, Washington D.C.

Mr. Alex Stolar	Programme Officer, Bureau of International Security and Non-Proliferation, Department of State, Washington D.C.
Ms. Kelly Hartley	Dr., Foreign Affairs Officer, Bureau of Arms Control, Verification and Compliance, Department of State, Washington D.C.
Ms. Kimberly Orr	Dr., Senior Biologist, Bureau of Industry and Security, Department of Commerce, Washington D.C.
Ms. Jen Gaudioso	Dr., Head of International Biological Threat Reduction Programme, Sandia Labs, Department of Energy National Nuclear Security Administration, Albuqerque
Mr. Matt Lim	Dr., Senior Policy Advisor in Global Health Security, Department of Health and Human Services, Washington D.C.
Ms. Debbie Little	Office of the Joint Chiefs of Staff, Department of Defense, Washington D.C.
Ms. Carol Walters	Lt. Col., Office of the Secretary of Defense, Department of Defense, Washington D.C.
Mr. Rob Weyant	Dr., Director, Division of Select Agents and Toxins, Centers for Disease Control Prevention, Atlanta
Ms. Laura Jevitt	FBI Biological Countermeasures SME, Federal Bureau of Investigation, Denver
Ms. Heather Wingard	Advisor, Permanent Delegation to the Conference on Disarmament, Geneva
Ms. Karen Fang	Science Advisor, Permanent Delegation to the Conference on Disarmament, Geneva

Mr. Ryan Morhard	Senior Management Analyst, Assistant Secretary for Prevention and Response, Department of Health and Human Services, Washington D.C.

Uruguay

Sra. Diana Pi	Chargé d'affaires a.i., Misión Permanente, Ginebra
Sra. Cristina González	Ministro Consejero, Misión Permanente, Ginebra
Sr. Alvaro Bellón	Dr., Asesor Legal, Misión Permanente, Ginebra

Venezuela (Bolivarian Republic of)

Sra. Rebeca Sánchez Bello	Embajadora, Representante Permanente Alterna, Misión Permanente, Ginebra
Sra. Maria Elena Dos Santos	Apoyo Técnico

Yemen

Mr. Mithaq Ali Ahmed Aljarf	Third Secretary, Permanent Mission, Geneva

B. States signatories

Haiti

M. Joël Especa	Directeur, Institutions internationales, congrès et conférences

Myanmar

Mr. Kyaw Moe Tun	Minister Counsellor, Permanent Mission, Geneva
Mr. Thu Rein Saw Htut Naing	Second Secretary, Permanent Mission, Geneva

Nepal

Mr. Deepak Dhital	Joint Secretary, Ministry of Foreign Affairs

United Republic of Tanzania

Mr. Edward Victor Masalla	Col., Dr., People's Defense Forces, Headquarter, Dar es Salaam Head of Delegation
Mr. Deusdedit B. Kaganda	Minister Plenipotentiary, Permanent Mission, Geneva

C. Observers

1. States neither Parties nor signatories

Israel

Mr. Eviatar Manor	Ambassador, Permanent Mission, Geneva Head of Delegation
Mr. Eitan Levon	Minister-Counsellor, Deputy Representative to the Conference on Disarmament, Permanent Mission, Geneva

Mauritania

Mme El Aliya Mint Menkouss	Secrétaire générale, Ministère des affaires étrangères et de la coopération
M. Abdel Kader Mohamed Ahmedou	Ambassadeur, Directeur des affaires européennes

2. Specialized agencies and intergovernmental organizations

European Union

Mr. Dominic Porter	Chargé d'affaires a.i., Permanent Delegation, Geneva
Mr. Andras Kos	Minister Counsellor, Permanent Delegation, Geneva
Mr. Nico Frandi	Policy Officer, European External Action Service, Brussels
Mr. Jean Pascal Zanders	Senior Research Fellow, The Trench, Ferney-Voltaire
Ms. Anna Margareta Andreasson	Intern, Permanent Delegation, Geneva

Food and Agriculture Organization (FAO)

Ms. Raquel Santos	Consultant, External and Advocacy Relations, Humanitarian Affairs, Liaison Office, Geneva

International Committee of the Red Cross (ICRC)

Mr. Neil Davison	Science Adviser, Arms Unit, Legal Division
Mr. Robin Coupland	Medical Adviser, Assistance Division
Mr. Johnny Nehme	Head, CBRN Sector, Weapons Contamination Unit, Assistance Division
Mr. Stephen Alexander Donnelly	CBRN Technical Adviser, Weapons Contamination Unit, Assistance Division
Ms. Ioanna Voudouri	Legal Attaché, Legal Division

International Criminal Police Organization (INTERPOL)

Mr. Guy Collyer	Coordinator of Bio-Terrorism Prevention Unit, CBRNE Sub-Directorate
Ms. Josefina Borghi	

Organization for the Prohibition of Chemical Weapons (OPCW)

Mr. Shawn DeCaluwe	Head, Assistance and Protection Branch, International Cooperation and Assistance Division
Mr. Jonathan Forman	Science and Policy Adviser, Office of Strategy and Policy
Mr. Kenneth Aoki	Senior Policy Officer, Office of Strategy and Policy
Mr. William Kane	Member of the Scientific Advisory Board, Chair of the Temporary Working Group on the Convergence of Chemistry and Biology

World Health Organization (WHO)

Dr. Isabelle Nuttall	Director, Global Capacities, Alert and Response
Dr. Cathy Roth	Adviser to Assistant Director-General Health Security
Dr. Stella Chungong	Coordinator, Global Preparedness, Surveillance and Response
Dr. Florence Fuch	Coordinator, Capacity Assessment, Development and Maintenance
Dr. Maurizio Barbeschi	Scientist, Global Preparedness, Surveillance and Response
Dr. Sebastien Cognat	Technical Officer, Capacity Assessment, Development and Maintenance
Mr. Nicolas Isla	Technical Officer, Global Preparedness, Surveillance and Response

World Organisation for Animal Health (OIE)

Mr. Keith Hamilton	Dr.
Mr. Dawid Visser	

3. United Nations

United Nations 1540 Committee Group of Experts

Mr. Terence Taylor	Coordinator, New York

United Nations Interregional Crime and Justice Research Institute (UNICRI)

Mr. Marco Musumeci	Programme Coordinator
Mr. Andrea Lacroce	

United Nations Institute for Disarmament Research (UNIDIR)

Mr. Marc Finaud	Resident Senior Fellow

United Nations Office for the Coordination of Humanitarian Affairs (OCHA)

Mr. Rashid Khalikov	Director, Geneva
Ms. Emilia Wahlstrom	Focal Point for Chemical, Biological, Radiological and Nuclear Issues, Joint UNEP/OCHA Environment Unit

United Nations Office for Disarmament Affairs (UNODA)

Mr. Nikita Smidovich	Senior Political Affairs Officer, Weapons of Mass Destruction Branch, New York

4. Guests of the meeting

Developing Countries Vaccine Manufacturers Network (DCVMN)

Ms. Sonia Pagliusi	Dr., Executive Secretary

Global Network of Science Academies (IAP)

Mr. Ryszard Stomski	Prof., Biosecurity Project, Polish Academy of Sciences, Member of the IAP Biosecurity Working Group

MIT Center for International Studies

Mr. Kenneth A. Oye	Director, Programme on Emerging Technologies, Associate Professor of Political Science and Engineering Systems

Biotechnology Industry Organization (BIO)

Ms. Phyllis Arthur	Senior Director, Vaccines, Immunotherapeutics and Diagnostics Policy
Mr. Paul Sheives	Director, Diagnostics and Personalized Medicine Policy

Mr. Akhila Kosaraju	Dr., Vice-President, Global Development, SIGA Technologies
Mr. Peter Tulkens	Managing Director, Polit Bureau, Brussels
Ms. Elizabeth Posillico	Dr., President and CEO, Elusys Therapeutics Inc.
Ms. Andrea Wilkinson	Global Brands Director, Government Affairs, AstraZeneca
Dr. Michael Wong	Senior Medical Director, Infectious Disease, Sarepta Therapeutics

5. Non-governmental organizations

Bavarian Nordic

Mr. Jacob Thorup Cohn	Vice President, Governmental Affairs
Mr. Jesper Elsgaard	Director, Governmental Affairs
Mr. Robert Kadlec	Dr., Consultant
Mr. Janak Raj Bhardwaj	Dr., Consultant

BioWeapons Prevention Project

Mr. Richard Guthrie	Consultant
Ms. Kathryn Millet	

Charles University in Prague

Ms. Dagmar Rychnovská	PhD Researcher

International Network of Engineers and Scientists for Global Responsibility (INES)

Ms. Kathryn Nixdorff	Prof., Coordinator, Studies on Biological and Toxin Weapons Control, Department of Microbiology and Genetics, Darmstadt University of Technology

King's College London

Mr. Nicholas Sims	Emeritus Reader, Department of International Relations, London School of Economics
Ms. Filippa Lentzos	Dr., Senior Research Fellow, Department of Social Science, Health and Medicine
Ms. Claire Marris	Dr., Senior Research Fellow, Department of Social Science, Health and Medicine
Ms. Paola Bello	European Projects Officer, Department of Social Science, Health and Medicine

National Academies of Science (NAS)

Ms. Katherine Bowman	Senior Programme Officer, Board on Life Sciences
Mr. John Clements	Professor, Tulane University
Ms. Nancy Connell	Professor, Rutgers New Jersey Medical School
Ms. Rita Guenther	Senior Programme Officer, Committee on International Security and Arms Control
Ms. Jo L. Husbands	Scholar, Board on Life Sciences
Ms. Abigail Male	Postdoctoral Researcher, University of Southhampton, United Kingdom of Great Britain and Northern Ireland
Ms. Alemka Markotic	Professor, University of Rijeka, Croatia
Ms. Frances Sharples	Director, Board on Life Science

Palladin Institute of Biochemistry NASU, Ukraine

Ms. Galyna Gergalova	Dr., Education and Awareness-Raising in Ukraine Project
Ms. Iaroslava Maksymovych	Dr., Education and Awareness-Raising in Ukraine Project

Pax Christi International

Mr. Trevor Griffiths	

Research Group for Biological Arms Control

Mr. Gunnar Jeremias	Hamburg Research Group, University of Hamburg
Mr. Mirko Himmel	Dr., Hamburg Research Group, University of Hamburg
Mr. Jakob Hersch	Hamburg Research Group, University of Hamburg

The George Washington University

Ms. Julie E. Fischer	Dr., Associate Research Professor, Health Policy and Co-Director, Global Health Security Programme, Milken Institute School of Public Health

Université Paris Sorbonne

Mme Charlotte Beaucillon	Maître de conférences en droit public, École de droit

University of Bath

Mr. Brett Edwards	Department of Politics, Languages and International Studies
Mr. Ralf Trapp	Dr., Biochemical Security 2030 Project

University of Bradford

Mr. Graham S. Pearson	Visiting Professor of International Security, Department of Peace Studies
Mr. Malcolm R. Dando	Professor of International Security, Department of Peace Studies
Ms. Tatyana Novossiolova	Doctoral Candidate, Department of Peace Studies

University of Calgary

Ms. Laura Fader	Undergraduate Researcher
Mr. Daniel Ziemianowicz	Undergraduate Researcher

Ms. Ainna Randhawa	Undergraduate Researcher
Ms. Victoria Fraser	Undergraduate Researcher

University of Exeter

Mr. Brian Balmer	Dr., Professor, University College London
Mr. Sam Evans	Dr., University of California, Berkeley
Ms. Chandre Gould	Dr., Senior Research Fellow, Institute for Security Studies, South Africa
Mr. Brian Rappert	Dr., Professor

University of Sussex

Mr. James Revill	Dr., Research Fellow, Harvard Sussex Program
Mr. George Oates	Postgraduate Researcher, Harvard Sussex Program

Verification Research, Training and Information Centre (VERTIC)

Mr. Scott Spence	Acting Programme Director
Ms. Yasemin Balci	Legal Officer